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ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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No. 1

ORIGINAL MEMOIRS.

HYPERTROPHIC STENOSIS OF THE PYLORUS IN INFANTS.*

BY ARTHUR LYMAN FISK, M.D.,

OF NEW YORK,

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PYLORIC stenosis in infants has within the last twenty years, only, especially commanded the attention of the profession, although the earliest record of a case of this sort goes back to 1788, when Hezekiah Beardsley, of New Haven, Connecticut, gave the history of a child which had "puking and regurgitation of milk," from birth until the time of death at five. Following this report there is an interval of fifty-three years before the second case was recorded by Williamson, in 1841, and in the following year Dawaski reported the third case. Both of these infants died when five weeks old. After this there was another long interval of forty-six years, when Hirschprung, of Copenhagen, in 1888 again brought stenosis of the pylorus in infants to the notice of the medical profession. Since which time an active interest has obtained, so that, at the present time, there is a record of 121 cases.

* Read before the New York Surgical Society, March 28, 1906.

Ibrahim states that of 113 cases, 50 occurred in Germany, and 49 in England; 71 of the cases were operated upon, and 50 died without surgical interference.

Stern¹ was the first to attempt surgical treatment, in 1897, in a correctly-diagnosed case. Scudder credits the first operative case to Meltzer in 1898, and the first successful operative case to Löbker, on July 25, 1898.

Symptoms.—In about every case it has been noted that the infant was a “fine baby.” Many of the cases are in breast-fed infants.

The first symptoms may come on a few hours after birth or may not appear for a month or more. Usually they appear in the second or third week. Until vomiting commences there may be no evidence of anything wrong. There may be flatulence and constipation. Vomiting is *the* prominent and characteristic sign. The intervals between the attacks may be fairly long. In well-marked cases several feedings may be kept down and then apparently the whole lot is brought up at once. Vomiting gradually becomes more and more frequent, and may occur on the administration of the smallest quantities of food. The act of vomiting is *forcible* (projectile); it causes some pain, and the infant is most comfortable when the stomach is empty. The character of the vomiting depends upon the diet. Change of food causes a cessation in the vomiting, often, for a short time, but it soon recurs. No bile is present. Constipation may be present throughout and may be a marked feature. It is not invariably present, being dependent upon the amount of stenosis. Sometimes there is actual diarrhœa. This results from irritation from decomposed or unusual foods which pass through the pylorus. The tongue is clean and the breath sweet in typical cases. Upon inspection of the abdomen usually there is distinct evidence of gastric dilatation and visible peristalsis may be present. In a marked case a wave of peristalsis may be seen passing from left to right, stopping

¹ Deut. Med. Woch. 1898, p. 601.

at the pylorus momentarily and then passing on downward into the duodenum. Tapping the epigastrium or applying cold may start this wave. The pylorus can usually be felt on careful palpation.

The average position of the pylorus can be marked on the body by the intersection of two lines; one drawn horizontally half way between the top of the sternum and the pubic crest, the other drawn vertically a little way (one-half inch) to the right of the middle line (Cunningham). Cautley says it is about one-half inch to the right and three-quarters of an inch above the umbilicus. It is deeply seated and feels about the size of a filbert. Cautley states that he has been able to feel it in the last five of his cases.

Wachenheim says that "Palpation of the pylorus is of an uncertain quantity and is frequently rendered difficult or impossible by the almost continuous crying of the infants, with resultant tension of the abdominal walls."

The body weight decreases rapidly and emaciation is often extreme. The ratio of sex is: males, 2.5 to females 1.

The following case was admitted to the Babies' Hospital in February, 1906, the second case only in the history of the hospital:

E. M., born December 24, 1905. U. S. Female, white. Normal birth. Weight $8\frac{1}{2}$ pounds. Breast fed. At two weeks given a bottle at night, next day vomited at breast. Given three bottles in all, then stopped. Gained seven ounces in the following week. Vomiting ceased for one week, then commenced again; after each nursing explosive vomiting. Change of food and careful regulation of no avail. Entered Babies' Hospital February 3, 1906. Child much prostrated, eyes sunken, color grayish; appears to be dying. Heart and lungs normal. Abdomen depressed, little fat, no mass, temperature 99.2° , weight 7 lbs. $9\frac{1}{2}$ oz. Given barley water. During February 3, child retained nothing by rectum or stomach.

February 4, retained a little 1-6-90. Vomited three times during the day, and three times at night. Stool meconium.

February 5, retains some breast milk. Temperature, 104° . Rectal irrigation expelled, also lavage.

February 6, vomited twice; 50 c.c. salt solution subcutaneously. Meconium stool. Temperature, 101.4° .

February 7, doing better. Vomited once in twenty-four hours. Temperature, 99° . Fecal stool.

February 8, vomited four times.

February 9, vomiting; losing ground.

February 10, condition same. Weight 7 pounds, $8\frac{1}{2}$ ounces. Temperature, 101.2° .

February 11, regurgitating and vomiting. Cries considerably. Pyloric tumor not felt. No peristaltic wave.

February 12, given breast milk; still vomiting. Weight, 7 pounds, $9\frac{1}{2}$ ounces.

February 14 and 15, vomiting persists.

February 17, peristaltic wave noticed. Vomiting. Given condensed milk.

February 18, condensed milk retained.

February 20, vomiting considerably. Operation advised.

February 21, child exceedingly prostrated, does not respond to stimulation.

February 22, decidedly weaker. Operation not thought advisable because of the child's weak condition and failure to respond to stimulation.

February 23 and 24, progressively weaker, persistent vomiting.

February 25, died.

Autopsy.—Stomach capacity two ounces. Through the walls the pylorus feels very thick and cartilaginous; on opening it a large amount of mucus was found covering the mucosa, which is pale. No food present. A probe one-eighth of an inch in diameter passes through the pyloric orifice easily but leaves no space about it. The pyloric valve is hypertrophied, measuring one-fourth of an inch in thickness, and the circular muscle coat stands out as the cause of the thickening. The thickened area is one inch long. Intestines normal. Section of the pylorus. The glands of the epithelium of the mucosa are normal. The muscular circular coat is very thick; it is thick over a wide area, a distance of one inch from the pyloric opening, where the contrast

between it and the narrow muscular coats of the duodenum is much more marked than is the contrast between it and the slightly less thickened circular muscle of the stomach, beyond the beginning of the pyloric valve. Just at the orifice, the longitudinal muscle is also hypertrophied; but not as markedly as in the circular coat. The mucosa is wider; its rugæ higher, as if the submucosa were looser over the hypertrophied valve than over the rest of the stomach. This difference is very marked, and to it some of the thickness of the valve is due. The vessels are normal and the peritoneal coat also. There is no connective tissue hypertrophied in any coat.

Pathological Anatomy.—Every case examined post-mortem has shown abnormal conditions. An unusual thickness, also length of the pylorus, has always been found. The length is about one inch. The consistency is so firm that it has been described as cartilaginous. Similar conditions have also been found by surgeons operating on these cases. The thickening of the pylorus is most marked at the duodenal end and thins off towards the stomach, so that the pylorus projects into the duodenum in a cone-shaped manner not unlike the portio vaginalis uteri.

The stenosis is not complete, for it is easy to pass a probe through. For practical purposes, it may be regarded as complete in most cases, for the mucous membrane is thrown into folds by the contraction of the fibres of the circular muscle or into one longitudinal fold, which stands out when the pylorus is laid open like the verumontanum in the prostate. "Indeed, the stomach in appearance and feel curiously resembles the dissected out bladder and prostate, the latter being comparable to the pyloric portion. This fold of mucous membrane completes the obstruction of the lumen of the bowel during life" (Cautley).

Microscopic Examination has demonstrated an abnormal thickness of the circular muscular fibres and at times, also, thickening of the longitudinal muscular layer. The entire tumor-like structure consists of muscular tissue as a rule. The products of acute inflammation are scarcely ever found. A

number of authorities have described the presence of other structures: connective-tissue increase between the muscular fibres, thickening of the submucosa, thickening of the mucosa, and in one case an evident secondary small ulcer was found. The serosa was always unchanged. The stomach is often dilated.

Prudden discovered in Meltzer's case a fibrous hypoplasia of the circular muscular fibres. Gran, in 1896, published records of microscopic measurements in cases of stenosis of the pylorus and measurements of the normal pylorus for comparison, which confirmed the gross appearance of hypertrophy. Still, in 1899, reported measurements of eight normal pylori in infants, from one month to twelve months, with which he compared three cases of hypertrophied pylori. He gives the average total thickness of the pyloric walls in healthy infants of six months as 2.5 mm., with a range of one-third more or less. In the case of hypertrophy the total thickness in the three cases was, first, 3.5 mm.; second, 3.7 mm.; third, 5.7 mm. The fact demonstrated by his measurement is, that the chief pathological change in these pylori is an enormous hypoplasia of the circular muscular fibres of the pylorus and adjacent stomach walls.

Pfaundler established an index for the size of the lumen of the pylorus for different ages from birth to twelve months. According to the French scale it runs from nineteen to thirty-two.

Etiology.—Three theories have been advanced in explanation of this condition. Two acknowledge the pathological anatomical lesion as a muscular hypertrophy; one claiming it to be a true malformation; the other to be a secondary hypertrophy due to muscular exercise, occasioned by continuous pyloric spasms, probably existing before birth. The third theory denies the presence of the anatomical lesion, and refers the symptoms to spastic conditions of the pylorus, claiming, that the post-mortem conditions are found in normal stomachs as well.

No case presenting the characteristic symptoms has failed to show the characteristic lesions at autopsy. These anatomical lesions would exclude the symptoms as being due to spasm alone. It is possible that we may find cases of pure pyloric spasm in infants without anatomical lesions, and some of the clinical histories would seem to make this probable. If we feel justified in abandoning Pfaundler's hypothesis of spastic pyloric spasm and assume that there is a true anatomical lesion in most, if not all, of the cases, we must decide, if this is a secondary hypertrophy due to disturbed coördination in the stomach innervation, leading to continued spasm of the pylorus, or if there is an original abnormal development of the muscular structure. The frequent late development of the symptoms after birth would indicate a spastic nature of the condition, but in children presenting symptoms immediately after birth a true stenosis seems indicated. It does not seem reasonable that such a decided hypertrophy could develop in so short a time as the result of spastic contraction.

In assuming the anatomical-obstruction theory it is necessary to explain how many of these children do well for several weeks after birth and then develop the symptoms. It is possible, in these cases, that the hypertrophy of the stomach-wall succeeds in forcing the food through the stenosed pylorus at a time when small quantities of food are taken. When the child takes a larger amount of food the work of expelling it becomes too much for the stomach-wall and the symptoms follow the retention. Swelling of the mucous membrane may lead to increased stenosis at any time. Edmund Cautley believes the condition to be due to a simple redundancy of foetal growth. Nature in her extreme anxiety to provide an effective pyloric sphincter has overexerted herself and has produced too great a quantity of muscular tissue.

Diagnosis is based on the history of progressive wasting, vomiting increasing in frequency and characteristic of pyloric obstruction,—i.e., explosive; constipation, clean tongue, sweet breath, dilatation of the stomach, visible peristalsis, and the

presence of a tumor. It must not be mistaken for simple regurgitation of food so common in infants, or simple gastritis. The absence of bile in the vomitus is also important.

Therapy.—In true stenosis of the pylorus medical treatment has no place, and, if in suspected cases, after ten days or two weeks of the most careful feeding and internal treatment relief is not secured, surgical measures should be adopted, before the infant becomes too debilitated and emaciated.

Meltzer gives the average age at onset as two weeks, and that at death as nine weeks and a half; and states "in view of the remarkable uniformity of the statistics, every case that runs beyond four months cannot be one of almost or quite complete occlusion of the pylorus." Cautley thinks "that the noteworthy fact is, that a fatal issue results before the fourth month of life, in infants not operated upon." Therefore, early diagnosis followed at once by operation, before the infant has had time to lose much weight, or become enfeebled, is especially essential to a successful surgical outcome; even more so, it would appear from the statistics, than the method of operation. Thus of forty cases of gastro-enterostomy with twenty-one recoveries and nineteen deaths, the average age of the successful cases at the time of operation was 6.7 weeks; while the average age at time of operation in the unsuccessful cases was eight weeks. Ibrahims gives nineteen cases with nine recoveries and ten deaths; the average age at time of operation in these was 8.15 weeks.

In the cases in which divulsion was performed, Scudder gives eleven cases with seven recoveries and four deaths; the average age in the successful cases was 6.7 weeks. Ibrahims, fourteen cases, seven recoveries and seven deaths; average age at time of operation, 7.5 weeks.

In cases of pyloroplasty, according to Scudder, of eight cases, four recoveries and four deaths, the average age of successful cases was 6.1 weeks. Ibrahims, nine cases; five recoveries and four deaths; ages not given.

(G. E., GASTRO-ENTEROSTOMY; A. G. E. OR P. G. E., ANTERIOR OR POSTERIOR; P., PYLOROPLASTY; D., DIVULSION.)

Name.	Year.	Age (weeks.)	Opera- tion.	Result.
Stern,	1897	6	G.E.	Died.
Meyer,	1898	6	G.E.	Died.
Meyer,	1898	6	G.E.	Died.
Lobker,	1898	10	P.G.E.	Recovery.
Fritzsche,	1898	6	G.E.	Recovery.
Lobker,	1899	7	P.G.E.	Died.
Abel,	1899	8	A.G.E.	Recovery.
Nicoll,	1899	6	D.	Recovery.
Kehr,	1899	8	G.E.	Recovery.
Kehr,	1899	8	G.E.	Recovery.
Braun,	1900	10	P.	Died.
Schmidt,	1900	8	D.	Recovery.
Stiles,	1900	8	Pylorectomy	Died.
Stiles,	1900	5½	G.E.	Died.
Von Mikulicz,	1900	9	G.E.	Died.
Nicoll,	1900		G.E.	Recovery.
Nicoll,	1900		G.E.	Recovery.
Nicoll,	1900		G.E.	Recovery.
Nicoll,	1900		G.E.	Recovery.
Nicoll,	1900		G.E.	Recovery.
Monnier,	1901	6	A.G.E.	Recovery.
Trautenroth,	1901	5½	A.G.E.	Recovery.
Gruneberg,	1901	5½	D.	Died.
Jordan,	1901	7½	G.E.	Died.
Jordon,	1902	9	G.E.	Died.
Gillavry,	1902		P.	Died 5 weeks.
Dent,	1902	8	P.	Recovery.*
Dent,	1902	10	P.	Recovery.
Braun,	1902	6½	G.E.	Died.
Burghard,	1902	8	D.	Recovery.
Burghard,	1902		D.	Recovery.
Stiles,	1902	4	D.	Died.
Stiles,	1902	5	D.	Recovery.
Stiles,	1902	10	D.	Recovery.
Stiles,	1902	9	D.	Died.
Stiles,	1902	5½	D.	Died.
Lendon,	1902		D.	Died.
Granboorn,	1902	3	P.	Died.
Schotten,	1902	6	P.G.E.	Died.

* Died ten weeks after.

Name.	Year.	Age (weeks.)	Opera- tion.	Result.
Grissenn,	1903		D.	Recovery.
Shotten,	1903	5	A.G.E.	Recovery.
Mackay,	1903	20	P.G.E.	Died.
Mackay,	1903	6	D.	Died.
Jakh,	1903	4½	G.E.	Recovery.
Dent,	1903	8	P.	Recovery.
Dent,	1903	6	P.	Recovery.
Dent,	1903	5	P.	Recovery.
Nicoll,			D.	Died.
Nicoll,			D.	Recovery.
Stiles,	1903	4	D.	Died.
Stiles,	1903	10	D. & G.E.	Recovery.
Stiles,	1903	5	D.	Died.
Stiles,	1904	4	P.G.E.	Recovery.
Stiles,	1904	6	P.G.E.	Recovery.
Bull,	1904	4	P.G.E.	Died.
Dent,	1904	7	P.	Recovery.
Campbell,	1904	9	P.	Died.
Pinner,	1904	4	G.E.	Died.
Munro,	1904	7	P.G.E.	Died.
Guthrie,			P.	Recovery.
Bottomley,	1904	8	P.G.E.	Died.
Giles,	1904	7	P.G.E.	Recovery.
Munro,	1904	3	P.G.E.	Recovery.
Elting,	1904	64	A.G.E.	Recovery.
Nicoll,	1904		G.E.	Recovery.
Nicoll,	1904		G.E.	Died.
Nicoll,	1904		G.E.	Died.
Nicoll,	1904		G.E.	Died.
Scudder,	1905	2	P.G.E.	Recovery.
Scudder,	1906	3	P.G.E.	Recovery.
Rodgers,	1906	8	P.G.E.	Recovery.

The total number of cases operated upon is seventy-one. Of these, thirty-eight recovered and thirty-three died, giving 53.53 per cent. recoveries and 46.47 per cent. mortality.

Gastro-enterostomy was performed forty-two times; twenty-four patients recovered and eighteen died, giving 57.14 per cent. recoveries and 42.56 per cent. mortality.

Pyloroplasty was performed in eleven cases, with six

recoveries and five deaths; of the latter, one case survived the operation five weeks and another ten weeks; if these two are added to successful operative cases, it gives us eight recoveries and three deaths. The percentage ratio is as follows: 54.54 per cent. recoveries, 45.46 per cent. mortality, or 72.72 per cent. recoveries and 27.28 per cent. mortality.

Divulsion: Eighteen cases were so operated upon, with nine recoveries and nine deaths. One of the nine cases which recovered had to have a secondary gastro-enterostomy performed three weeks later; therefore, if this can be considered as a failure and added to the cases which died, as it certainly would have, it gives us eight recoveries and ten deaths. The percentage ratio, therefore, is 50 per cent. recoveries and 50 per cent. mortality, or 44.44 per cent. recoveries and 55.55 per cent. mortality.

Pylorectomy, one case; no recoveries and one death; mortality 100 per cent.

The mortality percentages of the four methods of operation, taken from Scudder's, Ibrahims', and my tables are as follows:

	Scudder. per cent.	Ibrahims. per cent.	Fisk. per cent.
Gastro-enterostomy	47.7	52.6	42.5
Divulsion	36.3	50.	50.
			55.5
Pyloroplasty	50.	44.4	45.4
			27.2
Pylorectomy	100.	100.	100.

If the relative percentage for the several operations is to influence the selection of the method of operation to be used, there would appear to be but little choice between gastro-enterostomy, pyloroplasty, and divulsion. But judging from the number of operations relatively in each group, and the opinions of the different writers, gastro-enterostomy appears to be the operation of choice. Of the total number of cases of gastro-enterostomy, the number is about equally divided between the anterior and the posterior operation. This operation

in infants should be done by suturing the parts together, and not by a Murphy's button.

Weill and Péhu consider gastro-enterostomy the operation of choice. Robson and Moynihan believe that gastro-enterostomy is the operation of choice in all such cases.

Scudder, in a recent article, writes that gastro-enterostomy is the operation of choice; Kocher's gastro-duodenostomy subpyloric is physiologically the ideal operation, and Finney's pyloroplasty cannot properly be performed under the physical conditions present because the pyloric tumor is too rigid.

Cautley and Dent, however, whose experience has been large, object to gastro-enterostomy for the following reasons: First, that it necessitates a considerable exposure of the abdominal contents: Second, that the operation must necessarily be more protracted than either pyloroplasty or divulsion of the pylorus: Third, that there is increased risk of protrusion of the intestines; and Fourth, that the incision has to be prolonged further down toward the umbilicus.

Ibrahims says that the shortest operation is the one most indicated, and that pyloroplasty and gastro-enterostomy posterior can hardly be classed as such; and that posterior gastro-enterostomy presents the following disadvantages: the largest incision; the longest time of operation; and the frequent recurrence of intestinal prolapse. Anterior gastro-enterostomy has the same difficulties to a certain extent. Mikulicz successfully operated upon a case by anterior gastro-enterostomy, which died two months later as the result of a diffuse intestinal hæmorrhage due to peptic ulcers in the walls of the duodenum opposite the anastomosis.

Dent contends that results equally good to those of gastro-enterostomy can be obtained by pyloroplasty, and that the operation is, on surgical grounds, to be preferred; also, it can be added, on physiological and anatomical grounds. He considers that the operation of pyloroplasty has been condemned on altogether insufficient grounds.

Monnier says that pyloroplasty is unsafe and often imprac-

ticable on account of the thickness of the pyloric walls. Also Robson and Moynihan write that pyloroplasty on account of the great thickness of the pylorus and its rigidity in its whole circumference is impracticable. "To sum up," writes Dent, "it would appear: First, That the balance of opinion is in favor of gastro-enterostomy, on the ground that recovery follows and that the operation meets the necessity of the case: Second, That pyloroplasty is not so much an unsuitable as an impractical operation." The latter opinion is one that in their cases (Dent's and Cautley's) seems clearly disproved. "Notwithstanding the extreme rigidity and thickness of the hypertrophied pyloric sphincter, no difficulty whatsoever was found in sewing up the wound transversely; indeed, the operation of pyloroplasty would be worthless and impracticable in almost all cases, if rigidity and thickness of the walls constituted an insuperable obstacle to its performance. The operation is really much easier, when the thickness is due to muscular hypertrophy, as in infantile pyloric stenosis, than when the pyloric region is thickened, tough, and fibrous, owing to inflammatory changes.

"In very young children it will be found that the stomach and duodenal walls can be approximated with exceedingly little trouble, and with no tendency whatsoever for the stitches to cut through. There is no need to drag the pylorus up into view. If the distended stomach be gently pressed back into the left flank, the pylorus will almost immediately rise up into the wound without any traction. The peristalsis and distention excited by the exposure and manipulation may be somewhat embarrassing, but the moment that the incision is made into the stomach the distention subsides and the rest of the operation is easy. The incision must divide freely the thickened tissues and extend well into the normal structures on each side. An inch is really rather a short incision and even in a very young child, if it be made considerably longer, there will be no difficulty in approximating the wound transversely. At the upper and lower angles the mucous membrane should be

attached respectively to the stomach and duodenal coats. The introduction and closure of the first suture at the widest part of the wound is likely to approximate the whole of the wound transversely, so that there is little trouble from the escape of the stomach contents. Five or six sutures are ample. The first suture is preferably a Halsted stitch. No difficulty was found in bringing the serous surfaces at the extreme angles of the transverse wound together in a satisfactory manner,—*i.e.*, the part where the thickness and toughness were greatest were almost as easily sewed together as the central normal parts of the wound. Embarrassment from distended intestines, usually the transverse colon, was controlled by simple irrigation with hot normal saline solution. The time of the operation was twenty minutes, and following the operation right decubitus was maintained to effect drainage."

Divulsion of the pylorus was first successfully done by Nicoll. The dilatation is done by means of dilators, urethral bougies, artery lamps, œsophageal dilators, cervical dilators, etc. This operation is crude and not surgically good, because it fails to definitely overcome and remove the cause of the stenosis, recurrence of the stenosis having occurred in a number of cases. Stiles had three recurrences,—one seven days, one eleven days and one three weeks after divulsion. This condition is entirely different from cicatricial stenosis in which when the cicatricial tissue has been thoroughly divulsed the tendency to stenosis is removed, but in hypertrophic stenosis the tendency of the muscular tissue is to again contract and retract also, and, therefore, to reproduce the stenosis. Moreover, decided traumatic injury is usually done, even to laceration of the serosa, which may cause fatal peritonitis.

The operation of pylorotomy is altogether too severe for these cases. It seems, therefore, that the choice of operation is between posterior gastro-enterostomy and pyloroplasty.

It is the opinion of the writer that preference should be given in selected cases to pyloroplasty, as it is physiologically, anatomically, and surgically, the more correct procedure. And

upon the authority of Dent it can be performed as easily and quickly as posterior gastro-enterostomy. Early diagnosis and early operation, before the infant has had an opportunity to lose much in weight, or has become greatly emaciated and enfeebled, so that its reparative power is greatly reduced or lost, is more essential to a successful outcome of surgical treatment than the method of operation, other things being equal. As in most abdominal surgical diseases, of which this must be considered one, delay is generally fatal.

PRIMARY SARCOMA OF THE OMENTUM.

REPORT OF A CASE AND A STUDY OF THE SUBJECT.

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STIMULATED by the following case, which appeared at the time to be one of great rarity, the writer, on looking up the subject of sarcoma of the omentum, was surprised to find that there was almost nothing in text-books of surgery or pathology in regard to it, and that what was given was often misleading and inaccurate. Not only is this true of sarcoma of the omentum, but also of omental tumors in general.

The writer's case is reported not only because of its rarity, but because its symptoms and signs gave no clue to the real pathological state, but simulated those of a common surgical condition. From a study of this case, and from an exhaustive study of periodical literature, certain definite conclusions can be drawn.

A married woman, 51 years old a patient of Dr. Bragdon, of East Boston, was brought to the accident-room of the Massachusetts General Hospital, October 14, 1903, and was admitted to the service of Dr. H. H. A. Beach, through whose kindness the writer, his assistant surgeon, was put in charge of the case. She had been seen in consultation by Dr. R. H. Fitz with Dr. Bragdon, and was sent to the hospital with a diagnosis of intestinal obstruction.

Family History.—Father died of "old age," mother of apoplexy. Eight brothers and sisters, all well.

Previous history.—Patient thinks she has been a well woman all her life. Two children, the youngest twenty-seven years old. ceased uneventfully three years ago. No previous attacks of Operation for lacerated cervix fourteen years ago. Catamenia abdominal pain or of trouble resembling the present one.

Present Illness.—About three weeks ago she first began to be uncomfortably distended and her bowels would not move for several days unless she took a strong cathartic, when she would have a number of small dark-colored movements. She has had no vomiting, no chills or fever. Distention has, however, increased. She has been troubled by eructations of gas, but has passed very little gas from the bowel; has taken but little food; thinks she has lost no weight.

Examination showed a well-developed and nourished woman, somewhat anæmic in appearance. Leucocytosis of 23,000 twenty-four hours after entering the hospital. Heart and lungs normal. Abdomen much distended, the skin being very tense; the muscles of the abdomen were not rigid. The abdomen was tympanitic everywhere except low down in both flanks, where dulness on percussion was present. The liver and stomach both appeared to be pushed up. No mass in the abdomen could be felt. Examination by the vagina and rectum was negative. A probable diagnosis of intestinal obstruction from malignant disease of the large intestine, presumably in the sigmoid flexure, was made, but, inasmuch as the symptoms did not point to complete obstruction of the bowel, and were not so acute as to demand immediate operation, it seemed wise to give her the benefit of twenty-four hours' observation and see what change the use of high enemata would effect in her condition. During the afternoon and night following her admission to the ward several attempts were made to secure a thorough movement of the bowels by various forms of high and low enemata; there was one small, black, tarry and very foul result, with the passage of a little gas. At the end of twenty-four hours the distension was about the same. The patient was seen in consultation by Dr. Fitz and other members of the hospital staff and all concurred with the writer in the probability of intestinal obstruction from malignant disease of the sigmoid flexure.

About thirty hours after the patient entered the hospital an operation was performed by the writer under gas and ether anæsthesia. An incision was made through the abdominal wall to the left of the median line. On opening the peritoneum bloody fluid under considerable tension gushed out. Cultures from this fluid showed subsequently no growth of bacteria. After about a quart

of fluid had escaped, a large, flat, spongy, hæmorrhagic tumor presented itself in the wound. The abdominal incision was enlarged so as to permit of thorough exploration and inspection, after which it became evident that the whole of the great omentum was much thickened and infiltrated with blood; its appearance was like that of a red bath-sponge about one inch thick. This sponge-like, wide-spreading mass was floating in and on top of the bloody fluid. Underneath this mass were coils of intestines which were everywhere pale and collapsed. Over the surface of this diseased omentum, as well as over the surface of the mesentery of the bowel in some places, were numerous white spots giving the appearance of a typical acute hæmorrhagic pancreatitis, save that the thickening of the omentum was excessive. From the general appearance, and largely because of these areas of what seemed to be fat necrosis, it was thought that the case might be one of sub-acute pancreatitis. Exploration of the region of the pancreas, however, showed no apparent pathological process. The tumor was confined to the great omentum and no extension could be discovered. A piece of the omentum was excised for pathological examination. Since the diseased omentum was very vascular and bled very freely when handled, and because of the poor condition of the patient, nothing further was done. The abdominal wall was closed, gauze and rubber-tube drainage being left in.

To briefly sum up the condition found at the time of operation: The peritoneal cavity was abnormally distended by bloody fluid and the thickened, sponge-like hæmorrhagic omentum, with numerous white necrotic areas, had floated up against the anterior abdominal parietes. The intestines were normal, not distended, not injected. So far as could be determined the other organs were not abnormal.

The patient recovered well from the anæsthesia and twenty-four hours after the operation, after the use of stimulants and subcutaneous salt solution, was in surprisingly good condition. No vomiting; little pain. Very free drainage of bloody fluid into the dressing. Bowels moved freely with small doses of calomel on second day after the operation.

The condition of the patient was one of comparative comfort and freedom from abdominal distention, with very slight febrile

reaction until she was removed to her home by her husband and friends, five days after the operation. She lived for five weeks after the operation.

The report of the pathologist, Dr. W. F. Whitney, upon the piece of omentum removed is as follows: "A small piece of hæmorrhagic, necrotic-looking tissue, which upon examination was found to be composed of a solid mass of large round cells, of varying size, among which were many mitotic figures. The blood-vessels were simply spaces hollowed out in the cellular growth. Large round-cell sarcoma."

The number of cases reported that have been accurately studied is very few, yet certain statements can be made as to the constant diagnostic symptoms and signs. There is no conclusive sign other than a palpable, flat, movable tumor with or without signs of fluid in the abdominal cavity. The main points in the writer's case favored the diagnosis of intestinal obstruction, although it is to be noted that there was no vomiting; that there was a leucocytosis of 23,000, and that the two small fecal movements that were obtained after enemata were black and tarry. While possibly these features were not given sufficient attention at the time, it is to be doubted if they should have aroused any suspicion as to the correctness of the diagnosis of intestinal obstruction.

From a study of the few similar cases reported in periodical literature, it can be seen that the symptoms and signs vary within wide limits, yet are mostly suggestive of chronic intestinal obstruction having for its origin malignant disease of the intestines, and that in nearly all the onset of the disease was so slow that the tumor was felt as a flat or vaguely rounded mass, and the presence of fluid in the abdomen was made out before abdominal distention and constipation became extreme. In this case the only positive diagnostic feature, a palpable tumor associated with fluid, could not be obtained. The majority of the reported cases differ from this in that there is a long period of gastric symptoms with malaise, loss of weight, vomiting, increasing constipation alternating with diarrhœa, and

vague abdominal pain, then a tumor is felt in the mid-abdomen, often first by the patient and in some cases a year or two before death; fluid is detected and the late stages are as in the writer's case, but most often associated with severe paroxysms of pain and vomiting. Bloody or dark stools are mentioned as having been seen in two cases; the cause of this has not been explained. Leucocytosis in the reported cases has not been studied.

The general symptoms in the writer's case were those of increasing intestinal obstruction, with abdominal distention and constipation, without pain, and with very little loss of weight. The progress of the disease was very rapid. A study of reported cases shows that it is usual for this disease to cause earlier symptoms of gastric and intestinal indigestion, gastric pain, nausea, vomiting, with loss of weight and strength for some time before a tumor can be felt. It may be fairly stated that in the majority of instances this disease will cause such preliminary symptoms, with or without alternating constipation and diarrhœa, for several weeks or months. It is noteworthy that in one or two of the cases the presence of a tumor was remarked from one to three years before the final critical symptoms set in.

MATAS¹ reports a case of primary sarcoma of the great omentum on which he performed a laparotomy and removed the entire omentum with secondary growths. (It is instructive to compare his case with that of the writer.)

The patient, a white man, 46 years old, had had symptoms of slight indigestion, nausea, and occasional vomiting after eating, with pain in the region of the pit of the stomach, for from three to five years. Three years before, he felt a fulness in the abdomen and a lump above the navel, painless, but increasing in size. Gradual loss of weight from two hundred to one hundred and forty pounds in three years.

Examination Before Operation.—Sound everywhere else. A distinct irregular ovoidal tumor mass was seen and felt projecting through the abdominal walls in the epigastric and umbilical regions. The tumor was hard and semi-elastic, quite movable up and down and to either side, not tender on manipulation. It is stated that the mass apparently floated about over the intestines. There was some ascites.

Upon operation about a gallon of clear yellow serum, not bloody,

was found, containing many floating particles of a transparent gelatinous substance. The tumor was a resisting, friable, shaggy mass covering the intestines, identical with the omentum. It involved the entire great omentum and was connected to the whole of the greater curvature of the stomach, the spleen and the colon; an outgrowth of the tumor involved the lesser omentum and another, an entirely independent mass, the size of a fist, was growing over the mesentery near the cæcum. The tumor closely resembled a large flat sponge, yellow-red in color, and consisted of a fine friable trabeculated stroma which enclosed in its meshes a translucent gelatinous matter. The regular tissue and fat of the omentum had been supplanted by this gelatinous substance. The tumor was about one and one-half inches thick, rigid and friable, so that whole pieces could be broken off with the fingers. The absolute lack of vascularity was remarkable so that it was possible to tear it off from the stomach and colon with scarcely any hæmorrhage.

Dr. Matas was not able to remove all the disease, but had to leave some shreds of tissue attached to the mesentery and viscera. The abdominal wound was closed with a gauze drain, which was removed on the third day. It is stated that the postoperative course was normal and without incident. The patient gained flesh after the operation and was able to work on his farm for two months, then the dropsical distention of his abdomen prevented work.

A year after this, at the request of the patient, Dr. Matas did a secondary operation and found the entire peritoneal cavity invaded by sarcoma. Pathological examination showed that the tumor was a typical myxosarcoma.

In this case of Dr. Matas's it is to be noted, in comparing it with the case of the writer, that the symptoms were of long duration; that the tumor was palpable early; that there was no constipation; that in appearance it was quite similar to the tumor in the writer's case, but was non-vascular and non-hæmorrhagic. Its cellular nature was said to be myxosarcomatous. The removal of the growth was possible because of the absence of vascularity, while in the writer's case removal was not to be considered because hæmorrhage from the slightest manipulation of the tumor was severe.

Primary tumors of the omentum of any sort are rare. A study of the records of the Massachusetts General Hospital shows that diseases or tumors of the omentum are exceedingly uncommon and that primary sarcoma of the omentum is of the greatest rarity. Since 1870 reports of only fourteen cases,

including that of the writer, were found in which the diagnosis of carcinoma or sarcoma of the omentum was recorded. In only one case, besides the case under discussion, was a positive diagnosis of primary sarcoma of the omentum made; all the other cases were undoubted secondary carcinoma or sarcoma. This was a case of sharply localized fibrosarcoma of the great omentum. A portion of the tumor was removed by operation, no extension to other organs found; the case died of peritoneal infection within three days after operation.

Many of the cases reported in periodical literature are lacking in careful descriptions and pathological details.

In 1883 Braun,² of Jena, operated on a case of probable primary myxosarcoma of the omentum. This, so far as is known, is the first reported case of tumor of the omentum in literature in which a careful microscopic diagnosis was made.

BRAUN's case was that of a man 34 years old, with symptoms of vomiting and severe epigastric pain with abdominal distention; a tumor the size of a man's head, movable, extending two fingers-breadth below the umbilicus, could be felt. The tumor occupied the great omentum, was twenty-seven centimetres long, twenty centimetres broad and twelve centimetres thick. It was tied off from the transverse colon and removed. There was a large amount of hæmorrhagic fluid in the abdominal cavity. It was stated that microscopic examination showed it to be a cystic myxosarcoma. The patient lived seven months.

In the same article Braun refers to a case reported by Czerny, that of a man 27 years old, in which case a similar tumor had been removed, together with a small piece of the stomach-wall.

Braun could only find reports of three cases of tumor of the omentum before the year 1885, and these were the cases of Simon, Pean and Witzel.³ There can be added to these cases the case of Colin.⁴ The pathology in these cases is uncertain. Colin's case was a large soft mass between the folds of the great omentum. Pean's case was a large hæmorrhagic cyst. The anatomical descriptions of most of the scattering cases reported before 1890 are incomplete and one cannot obtain a

clear idea of the relations of the tumor to the omental folds, the stomach or the colon.

Boormann,⁵ from a case of his own and one or two other cases, takes the ground that solid or cystic tumors of the great omentum are not primary tumors, but are false tumors of the omentum, and nothing but tumors originating in the walls of the stomach or the transverse colon. He is undoubtedly wrong in this point of view. He cites the case of Erlach⁶ in which a large myomatous tumor developed between the folds of the small omentum, which tumor had its origin in the muscular coat of the stomach; also the case of Segond,⁷ in which a very large cystic fibroid sarcoma completely enclosed by the folds of the great omentum, was so strongly adherent to the greater curvature of the stomach that it was necessary to resect a portion of that organ.

It can be stated positively that carcinoma cannot be primary in the omentum. No case has been found that on investigation did not prove to be either a secondary cancerous growth or an endothelioma.

Sturmdorf reports a case of primary carcinoma of the omentum and peritoneum, but furnishes no evidence that it was not a secondary growth.

It should be stated that knowledge of endotheliomata is still vague. Endotheliomata may simulate carcinoma here as elsewhere.

It is noteworthy that the gross appearance of secondary carcinoma, the so-called colloid cancer, of the omentum, and that of primary sarcomatous growths, myxosarcoma, or other forms of sarcoma at certain stages of degeneration, may be almost identical. Undoubtedly these curious spongy, vascular growths have been often inaccurately described and named. Most writers state that the sarcomata are invariably myxosarcomata; this is false; other forms of sarcoma, large round-cell, spindle-cell and mixed forms, as well as myxosarcoma, have been reported. The main reason for the confusion of ideas, aside from the scarcity of cases for study, seems to arise from

the tendency for all malignant growths of the omentum to disorganize, and for the cells to break down into gelatinous material and form cysts with gelatinous and hæmorrhagic contents. The appearance of most of these tumors is that of a nodular, vascular, spongy growth looking like a collection of strawberries, or as one writer has described it, a cherry pie, or a red sponge. Bland Sutton ¹⁰ in his book, "Tumors Innocent and Malignant," mentions this pathological condition as one frequently associated with cancer of the stomach, but states that the subject requires close investigation of perfectly fresh material for its proper elucidation.

Eve ¹¹ very carefully studied two cases, one a case of Lawson Tait, and one of Sir Spencer Wells, and clearly describes the minute pathology, proving each to be a sarcoma, stating that no trace of endothelial cells could be found in any portion of the tumor; that the name colloid cancer was inappropriate, although at the time of his writing such tumors were continually described as colloid cancer by accepted text-books. He concludes, very accurately, that true colloid cancer of the omentum is seen as a secondary affection, usually to disease of the ovary, but there is, on anatomical grounds, reason to believe that, if growths from the endothelium are excepted, primary cancer of this sort does not occur.

It is fair, therefore, to state that a certain percentage of the cases formerly called colloid cancer were sarcoma primary in the omentum.

It has been stated in text-books that among the primary growths of the omentum occur cysts, benign, hydatid or dermoid. In all probability many of the so-called cysts of the omentum are primary sarcomata; the contents of the cysts are largely due to hæmorrhage from the thin-walled blood-vessels of the sarcomatous portion of the cyst-walls. The cases reported by Reamy ¹² and Segond ⁷ strongly bear out this statement. The other primary tumors of the omentum are lipoma and fibroma. It has been stated that their occurrence is even more rare than sarcoma.

Primary sarcoma may originate in the posterior cavity of the omentum, starting from the lesser, or gastro-hepatic omentum. Only three such cases, however, have been reported. The tumor in these cases may grow down between the transverse colon and the stomach between the folds of the great omentum, as in the case of Gross and Sencert, or may push the stomach down into the pelvis, as in the case reported by Gould.

GROSS AND SENCERT¹³ report a case of a woman 53 years of age who had been previously well. For six months before had noticed vague abdominal pain coincident with loss of appetite and nausea at times, followed by obstinate constipation, which alternated at rare intervals with severe diarrhœa; never vomiting; never blood in the stools. For several weeks a tumor in the abdomen the size of a fist in the median line had been felt. A month before operation severe paroxysmal pain in the abdomen, with vomiting

Examination.—Thin and emaciated; some jaundice of conjunctivæ, no fever; heart and lungs normal. A tumor seen and felt in the abdomen occupying the umbilical region, extending into the hypogastric region and into the left flank, moving somewhat with respiration, rather fluctuating, giving the impression of a cyst of the ovary; percussion dull over the surface of the tumor, tympanitic in the flanks. Pelvic examination was negative; urine examination was negative. Provisional diagnosis: multilocular cyst of the ovary, or cyst of the mesentery. A few days after entering the hospital a long crisis of pain, absolute constipation; frequent vomiting of yellow bile; pulse 108; normal temperature.

At the operation a tumor whitish in appearance and covered with countless fatty spots and with numerous extremely dilated blood-vessels covered by the anterior fold of the great omentum was found. The anterior surface of the tumor was strongly united to the anterior layer of the great omentum by a number of strong bands enclosing very large blood-vessels. It was found that the tumor originated in the lesser omentum and had found its way into the greater omentum by pushing down the transverse colon. There was no involvement of the stomach. The tumor was not hæmorrhagic. There was no fluid in the abdomen. The tumor was removed with comparative ease. The patient died of shock in forty-eight hours.

At the autopsy it was found that it was a primary tumor of the omentum and not secondary to a growth of the stomach; that it originated in the lesser omentum; that its only connection to the stomach, colon and other viscera was the omentum with large blood-vessels. The tumor was the size of a man's head.

Pathological examination showed the tumor everywhere enveloped

by a fibrous membrane, soft, fluctuating, containing numerous cystic cavities. Most of the tumor had a water-soaked appearance like a sponge. The cystic and sponge-like areas of the tumor were interspersed with various-sized regions of firmer tissue; the spongy and cystic parts of the tumor were filled with bloody fluid.

Microscopic examination of the tumor showed the white and solid parts of the tumor to be the typical structure of sarcoma, spindle-cell sarcoma.

Attempting to explain the fact that in one case a tumor of the lesser omentum may push down the transverse colon and grow into the greater omentum, not displacing the stomach to any extent, while in another case the stomach is much displaced downward, Gross and Sencert state that in intra-uterine life there is free communication between the cavity of the lesser omentum and that of the greater omentum, and that exceptionally in adults the communication persists. The fusion of the layers between the transverse colon and the stomach does not in certain cases entirely obliterate the communication between the two pouches. Displacement of the stomach or colon by a growth from the lesser omentum depends also upon many factors, as adhesions, size of tumors, etc.

GOULD¹⁴ reports a case of sarcoma of the gastrohepatic omentum that is to be compared with the case of Gross and Sencert. It is a remarkable case because of the great displacement of the stomach and intestines and because the growth was removed and the patient lived over four years in good health. A man 38 years of age, family and previous history unimportant. Twelve months before admission to the hospital he noted that he was getting thinner about the face and stouter in the abdomen; the abdominal swelling kept on increasing. Three weeks before admission his symptoms were colicky pain and diarrhœa. His appetite had been good.

Examination.—Not greatly emaciated; pulse 66. Nothing said about temperature or white blood-count. Abdomen greatly enlarged, measuring 40½ inches in circumference at the level of the umbilicus. A tense, firm, uneven, non-fluctuating tumor with rounded outline was felt as far down as the right groin; the edge could be felt up to the eleventh rib on the right and to the tenth rib cartilage on the left. Below, a finger-tip could be inserted between the edge of the tumor and the pubis; the upper limit could not be felt; under the ribs the mass could be moved from side to side. Dulness over the whole surface of the tumor and

tympanitic percussion in each flank; there was no jaundice, no ascites, no œdema. Urine was normal.

At the operation the surface of the tumor presented; it was not connected with the liver, spleen or kidneys. The growth started in the lesser omentum and had pushed the stomach down into the pelvis. The attachment of the tumor behind was a strand of tissue in which were large blood-vessels. The lesser omentum seemed continuous with the tumor and required division and ligation of a dozen bleeding points. The patient recovered from the operation and left the hospital seven weeks afterward. Four years after operation he was apparently in excellent health and the stomach in its usual situation. The tumor weighed twenty-one pounds.

Microscopic examination showed that it was largely made up of extravasated blood. Areas of blood-cysts and blood-soaked tissue between which were more or less extensive strands of tissue composed of bundles of long narrow spindle-cells; a spindle-cell sarcoma, the substance of which was very friable. Diagnosis previous to operation was tumor of the great omentum.

Gould thought the fact that the absence of stomach resonance above a dull solid tumor, which was remarked as a prominent sign in this case, should have led to a diagnosis of a tumor starting in the lesser omentum. He seems to think that it was right to exclude a malignant growth because of the symptoms, but reference to almost all the cases will show that sarcomatous tumors of the omentum are noticed much longer than in his case. His case was a rapid one, as was the case of the writer.

Only one other case of primary tumor of the small omentum has been found, a case referred to by Owen. In this case no microscopic diagnosis was made, although from the appearance and vascularity of the growth it was in all probability a sarcoma.

DOUGLAS¹⁵ reports a case of myxosarcoma primary in the great omentum. For six months previous to the operation, constipation, colicky pains in the abdomen, weakness and loss of flesh. The tumor was felt with difficulty and was not very movable. At the operation a large flat tumor made up of numerous little cherry-red lobules, like a "cherry pie," no mention of fluid in the abdomen. This tumor was removed close to the colon. Patient died in four days of gastric hæmorrhage.

Post-mortem examination resulted in a diagnosis of primary myxosarcoma of the great omentum with no secondary involvement.

In connection with this death from gastric hæmorrhage, Lauenstein¹⁶ lays stress upon hæmorrhage from the stomach and duodenum as a possible danger in operations upon the omentum with removal of the whole or a part. He states that Eiselberg has seen such a case, and that Friedrich has experimented on dogs and guinea-pigs in relation to this and found that the resection of the omentum was liable to cause ulcers in the stomach and duodenum and multiple hæmorrhagic and necrotic areas in the liver; therefore, he advised great care in handling and removing the omentum.

ANDERS¹⁷ reports a case of a very large sarcoma of the omentum in a man 35 years old, which was in all probability primary in the omentum, but with secondary involvement of the liver with sarcomatous nodules. About two years before a small tumor low down in the abdomen, which gradually increased in size, was noticed. Abdominal pain, varied in severity, associated with constipation and occasional diarrhœa; later some frequency of urination and severe abdominal discomfort, with increased constipation. Four or five months after first noticing the tumor, he passed a tapeworm. On entering the hospital a hard, distinctly-nodulated, slightly-movable mass was felt in the abdomen, extending into the pelvis. At time of entrance to the hospital the liver was found to be normal in shape and size, whereas, a few weeks before death, it extended below the ribs and was felt as a large mass in the right hypocondrium. During the last weeks of life constipation was marked. Rapid loss of flesh; death suddenly, without operation. It is to be noted that the urine was normal, that the temperature chart for a short time showed only slight elevation of temperature. For a week before death it was sub-normal.

At the autopsy a large whitish-pink, non-vascular, markedly-lobulated and furrowed tumor-mass, extending from the top of the great omentum to the brim of the pelvis, was found. The entire mass was seen to depend from the great omentum at the root of which was attached a smaller mass. These two portions involved the omentum alone and were not connected with any of the neighboring structures. Small masses were found attached to the peritoneal covering of the sigmoid, one to the bladder and rectum. Everywhere in the liver were small and large nodules projecting from the surface. The structure of these nodes was exactly similar to the large abdominal growths. There was nothing else found at the autopsy.

Microscopic examination showed round-cell sarcoma.

Anders considers, and rightly so, from the history and pathological findings, that the growth was primary in the

omentum. His reasons are that the tumor was first felt in the region of the omentum; that there was no evidence to show disease of the liver until shortly before death. The extensive metastasis in the liver was noteworthy.

In addition to the cases referred to or outlined above it has been possible to find reports of but six other cases of primary sarcoma of the omentum.

ROCHFORD¹⁸ reports a case of a woman 37 years old. A slowly-growing tumor in the abdomen noticed for three years; for four or five months before operation severe abdominal pain and dulness; there was nothing stated about indigestion or constipation. Urine examination negative; white blood-count 11,000; temperature and pulse normal. No mention is made of ascites or of mobility of the tumor.

At the operation a large tumor, friable and spongy, having a mottled appearance was found. No other abdominal organs were affected. The tumor was removed with severe hæmorrhage. The result of the operation is not given. Microscopic examination showed spindle-cell sarcoma of the omentum.

SCHMIDLECHNER¹⁹ reports a case of a woman 48 years old. Tumor noticed in the abdomen for a year. No symptoms of indigestion or constipation; no emaciation; abdominal distention present. A tumor the size of a man's head, hard, slightly movable, extending far below the umbilicus, could be felt.

At operation an omental tumor, large, red and easily bleeding, adherent to the bladder, appendix and some of the intestinal coils, covered with a smooth, shiny and very vascular membrane, was found with many small cystic cavities filled with a brownish-red bloody fluid. It is stated that this tumor was a spindle-cell sarcoma originating in the connective tissues of the omentum and that the hæmorrhagic cysts were caused by sarcoma-cells having eroded the blood vessels. It is stated that half a quart of bloody serum was found in the abdomen. Technique of removal of this tumor is not given. It is stated that the patient nearly died from the operation, but eventually was up and out of bed in four weeks. Further history of this case not given.

CHIARLEONI²⁰ has reported a case of sarcoma of the large omentum in which torsion or rotation had taken place. No operation; nature of disease found at autopsy.

EVE reports a case of Spencer Wells in which a rapidly-growing omental tumor weighing eight pounds was removed by operation; a myxosarcoma. Its surface was covered by rounded bodies of various sizes, the largest nodule being half an inch in diameter. They were attached to the chief by threads, like currents on a stalk; they had a softish, homogeneous section and microscopically were composed of

hyaline bands of connective tissue, forming a wider or closer imperfect mesh-work of which the spaces were filled by branched connective tissue and round cells. Many of the cells were swollen and indistinct in outline from mucoid degeneration. No other details of this case are given.

EVE.¹¹ Case of Lawson Tait. Male, age not given. For eight months malaise and gastric indigestion, abdominal distention, loss of flesh, pain in the right hypocondrium and back, tenderness in the epigastrium, fluid rapidly accumulating in the peritoneal cavity. A lump behind the umbilicus and cartilage of tenth rib on the left side moving with the diaphragm, not tender, dull, was felt. After aspiration to relieve the great distention, operation February, 1885. A large tumor of the omentum sixteen inches in length, from above downwards, nine or ten inches or more. Its surface was very uneven, flocculent and shreddy, the flocculent appearance being produced by the projection of rounded masses of gelatinous material attached to the surface by shreds of tissue. The section had the appearance of a finely spongy texture, which reproduced a close mesh-work of narrow bands of indistinct connective tissue enclosing rounded masses of the same gelatinous material.

The tumor was incompletely removed owing to the alarming condition of the patient when the splenic corner was reached. Nothing is said about the result of the operation.

BRAIDWOOD²¹ reports a case of spindle-cell sarcoma of the omentum. He does not describe the gross appearance of the tumor. Case 46 years old, female, died with symptoms of vomiting, irregular bowels, abdominal pain, abdominal tumor. No operation, but nature of tumor found in post-mortem examination.

MILLER²² reports a case of a female 55 years old. Symptoms of epigastric pain, indigestion, nausea and constipation. Urine normal. Severe pain in the region of the umbilicus. It is not mentioned that any tumor was felt; the reason for this is probably because of the extraordinary amount of ascitic fluid. The patient was tapped three times in a few months and about two gallons of ordinary ascitic fluid was drawn each time. There was no operation, but an autopsy. The growth is described as composed of soft vascular, nodular masses like "strawberries."

The microscopic report was "Primary endothelial sarcoma," but a study of the details of the cellular pathology as described, and especially the statement that the vascular endothelium was unaffected, leads to the belief that the growth was a myxosarcoma, and the word endothelial inaccurately used.

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THE SURGICAL ASPECTS OF ANURIA.¹

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By the word anuria is understood that condition in which no urine is formed in the kidney; in other words, there is a complete absence of the secretion. Anuria following abdominal operations occasionally arises, but does not last more than forty-eight hours, although one case has been recorded in which there was suppression of the urinary secretion for twenty-five days, although the subject appeared to be perfectly well during this time. The urine then began to come away and gradually attained the normal amount. There are other cases, however, where anuria of several days' duration sets up phenomena met with in uræmia, and it is quite true that in certain pathologic conditions resulting in the development of deleterious substances in the blood, the patient may be in a very serious condition. These substances are the urinary toxins, combined with the biliary constituents and CO². Understood in the strictest sense, anuria only occurs in functional disturbances of the kidney, or in the various renal affections, but in a broader sense one can include under this name all those abnormal conditions in which the urine is prevented from reaching the bladder. Thus, we have obstruction arising in the ureter or renal pelvis, giving rise to suppression and which may be classified among cases of anuria. True anuria arises when the arterial blood no longer reaches the renal gland, or the escape of the urine secreted in the glomerulæ is prevented by some obstacle met with along the genito-urinary tract.

I would like here to outline a classification of conditions giving rise to various forms of anuria, with the hope that the

¹ Read at the annual meeting of the American Urological Association, at Boston, June 13-14, 1906.

subject may be made as simple as possible. I will first consider those cases resulting from a reflex action, and here one is dealing with anuria produced by some irritation in another organ, and by way of the nerves, the reflex action is carried to the kidney, resulting in suppression of secretion. In this class belongs anuria of hysteria and toxic anuria arising from the intestinal canal. There are also instances of suppression of the urine resulting from an irritation arising in one kidney which, by what is probably a reflex action, prevents the secretion of urine in the healthy organ as well. According to Cohnheim, the anuria of pregnancy should also be considered as of reflex nature and may be traced back to contraction of the renal arteries, but, however, I believe that in these cases an inflammatory process is really at the bottom. As an intermediary or transitional class we should include those cases of anuria which result from an obstruction at some part of the urinary canal, as occurs in certain infectious processes. Here, in all probability, the circulation becomes arrested in the kidney, usually as a result of cardiac weakness, or on account of an increased density of the blood, but the urinary canals of the kidney are usually filled with small plugs of casts, being in reality an obstructive process. The second group includes the anuria met with in nephritis, renal calculi, and in torsion or compression of the ureter, and these cases represent instances of obstruction in the urinary canals. We will now consider the first group, namely *reflex anuria*.

Hysterical Anuria.—It is well-known that the secretion of urine is directly under the control of the nervous system by means of the vaso-motor system. By irritation of the vascular centre in the medulla oblongata one can directly influence the amount of urine secreted by the renal parenchyma. Stimulation by electrical currents, or by inducing an accumulation of CO_2 in the blood, one may succeed, if the irritant is of sufficient strength to completely stop the secretion of urine. The point, however, which has by far the greatest importance for the understanding of the production of hysterical anuria,

is the resulting complete anuria by reflex which arises during irritation of a sensory nerve. In their experiments Cohnheim and Rog by stimulation of the central end of a cut sciatic nerve, successfully produced an extreme contraction of the renal vessels with a diminution in the size of the gland. It is very important to note, as these authorities have shown, that the effect of the irritation was present considerably longer than the duration of the stimulation. These experimental demonstrations form the foundation of the hypothesis of reflex anuria in the human subject. The question now arises as to how far clinical experiments correspond to those undertaken on animals and whether or not it can be demonstrated as a certainty that cases of purely nervous anuria can be met with, when the renal glands are absolutely normal. I feel that this may be answered in the affirmative, and here cases of hysterical anuria belong. This form usually arises in neurotic individuals, or in diseases or anomalies in the female genital apparatus. The splanchnic nerve becomes irritated and from this arises a cramp-like contraction of the renal arteries, while the flow of blood to the kidney completely ceases. Hysteria, which represents a perverted reaction of the nervous system, may give rise to changes in the urine due entirely to nervous influence. The polyuria which frequently follows attacks of the affection is well known and, although less frequent, oliguria may also occur and be so marked that anuria is reached. Pitres says, in his clinical lectures on anuria, that the patients succumb from uræmia after a certain time, which may vary from several hours to five or six days on an average, but in hysterical subjects, on the contrary, the anuria may persist for weeks without having any apparent effect on the general health and without causing any danger to life.

If one carefully studies the literature of the subject, it will at once become evident that hysterical patients never give evidence of symptoms of uræmia, *if vomiting and diarrhœa be excluded*. This has induced several authorities to assume that there exists a vicarious secretion of urea by way of the

stomach, and Charcot and others observed that in absolute anuria vicarious vomiting arose, the vomitus containing a relatively large amount of urea. The quantity of urea in the vomitus increased when the urinary secretion was suppressed, and, consequently, it becomes evident that the stomach possesses power to eliminate a certain portion of the urea accumulated in the blood in cases of anuria. The number of such cases, however, is small and there are probably other ways in which the urea becomes eliminated. That a vicarious secretion of urea may take place in the organism there is no doubt, as the experiments of Claude Bernard and Barreswil show. After removal of the kidneys they demonstrated the presence of urea in the blood, and after profuse vomiting had occurred it could no longer be discovered. This phenomena may be explained by the secretion of urea into the intestine and which is also removed partly by vomiting and partly by transformation into carbonic acid ammonia. Hammond and Marchand, as well as Oppler, found the presence of urea in the vomitus in their experiments.

One must be extremely careful in making a diagnosis of anuria when one suspects it to be due to hysteria. For instance, in one case, a girl twenty-four years of age occasionally presented an oliguria and once apparent absolute anuria lasting for two weeks and accompanied with violent vomiting. The patient was carefully watched and it was soon discovered that she carried a small pitcher with her which she kept wrapped up in a handkerchief. This pitcher had a very strong odor of urine. When she was unobserved, she would pour small quantities of urine out of the window, and it was also found that she drank some of it and then vomited.

We now come to the consideration of those cases where the anuria is proven to be purely nervous in origin and the kidneys perfectly healthy, and here again I would refer to Charcot, who published a very well-observed instance. The patient presented evidence of severe hysteria; there were convulsions, hemiplegia and hemianæsthesia with an oliguria,

which had been presented for several months, with periods of absolute anuria which lasted 11 days. During the whole time small amounts of urea were detected in the vomitus. After a deep chloroform narcosis, given for the purpose of breaking up adhesions giving rise to contracted joints, the urine secreted was found normal. This case shows that the long duration of an anuria proves nothing as far as its purely nervous nature is concerned, and this case just quoted was in all probability an angiospastic anuria and, besides, other proofs derived from animal experiments well demonstrate the curative action of the relaxing influence of chloroform narcosis over the vascular spasm. If, then, a nervous anuria really exists, it is probable that it is quite similar to the experimental reflex variety and results from sensory irritation, and this theory appears more or less probable from the two following reported cases. Israel had a 24-year-old woman under his care presenting a stenosis of the external os, uterine catarrh, and constant uterine pain which was increased at each menstruation. For six months oliguria had been present, accompanied by profuse vomiting and occasional anuria. After bilateral incision of the cervix the menstruation following was painless and the oliguria and anuria disappeared. A similar condition was found in a case reported by McBride and Mann, of a woman having intestinal irritation, uterine hypertrophy and a deep bilateral laceration of the cervix, and who usually presented an anuria of many hours' duration during menstruation. Injections of morphine did away with the anuria each time they were given, while an operation for the repair of the cervix also did away with it for some time.

Toxic anuria as it occurs occasionally in chronic lead-poisoning can also be traced to a reflex contraction of the renal blood-vessels, especially the arteries, but, under these circumstances, oliguria is more frequently present than anuria. The same may be said of oxalic acid and cantharides poisoning.

We now come to the question of reflex anuria arising in an occlusion of one ureter, which may be considered as of reflex

nature from the genital tract, and it is of importance to ascertain if sensory irritation affecting one kidney or one ureter is capable of suppressing urinary secretion by reflex action. This may be answered affirmatively, and the fact was already known as far back as Morgagni that in obstruction of one ureter the opposite kidney might sometimes suspend its functions, so that this great pathologist was led to say: "*Nam etsi non semper, haud rarissime tamen contingit, ut uno affecto rene alter quoque in consensum trahatur.*"

Clinically, this form of reflex anuria has been repeatedly met with, and as far as the correctness of the explanation is concerned, namely that, under certain conditions, an inhibitory influence upon the secretion of one kidney on the other can occur, it has been proven by physiological experiments. It was long ago demonstrated by Claude Bernard that, by irritation of the nerves entering the hilum of the kidney, anemia and anuria could be produced, while in contradiction to this, Cohnheim and Roy showed that by irritating the renal nerves a marked hypæremic tumefaction of the organ, with increased urinary secretion, resulted.

It is only recently, however, that investigations have demonstrated the paths over which the vaso-motor nerve fibres run, and this is of extreme interest from our point of view. Masius, by making a section of the vagus in the neck of rabbits and dogs, whether on the right or on the left side, could by irritation of the peripheral end produce suppression of urine in both kidneys. This phenomenon also took place when the sympathetic was cut in the neck after section of the vagi and the cervical medulla and the central end irritated. From this there resulted a depression in the vaso-constrictor nerve-fibres of the kidney, partly in the splanchnic, partly in the cervical vagi, and on account of this dividing course of the vaso-constrictors in the cervical vagi also, it immediately becomes obvious that, in a perfectly simple and clear manner, one may explain the changes observed in the cardiac action as well as the existing anuria. This has also been proven clinically. For many

English surgeons, however, the reality of reflex anuria resulting from functional obstruction of one kidney does not appear at all likely, and they only believe it possible when some serious lesion is present in the second kidney. Legueu rejects the possibility of a reflex action when a renal lesion exists on one side only, or when a calculus becomes lodged in a ureter, and he asserts that, in calculus anuria from obstruction of one ureter the kidney on the other side, if it fails to carry out its functions, does so because it is, or has been, the seat of some lesion. Demons and Pousson admit that anuria arising in cases of obstruction from stone in one ureter may occur, but it must be extremely rare and presumably a diseased kidney also exists, because it is only under these circumstances that the renal function could be interfered with in a reflex way.

Israel also comes to the conclusion that reflex anuria due to a one-sided obstruction of the ureter usually only takes place when the opposite kidney is already the seat of disease. The reflex interference of the renal function takes place, according to Guyon, from an insufficient blood-supply, due to irritation of the vaso-constrictors, and since he upholds that a diseased kidney requires a greater amount of blood than a healthy one, they naturally suffer more markedly under a reflex irritation than when normal.

Animal experiments carried out by Gotze would appear, however, to be in favor of some reflex influence being brought to bear on the healthy kidney which may impair the latter's functions in cases of obstruction of one ureter by a calculus. In dogs which have passed normal urine the capacity of each kidney was determined quantitatively by inserting a glass tube into each ureter. Salt solution was then injected into one ureter which increased the pressure of the respective kidney and immediately resulted in a decrease in the secretions of the kidney on the opposite side, and when the pressure was kept up resulted in complete suppression of urinary secretion. The same result was obtained when artificial obstruction of one ureter was produced. Increase of intrarenal pressure of one

kidney consequently resulted in arresting the secretion in the opposite gland. From this it would appear that those who have criticised the theory of reflex suppression of urinary secretion have certainly the merit of having disproven a large number of cases which have been reported as reflex anuria, but, nevertheless, the reflex process which arises in connection with renal operations must still be more generally considered than it has in the past. This relates chiefly to the immediate results on the functions of the remaining kidney after nephrectomy. The physiological process after this operation is much more clearly understood than formerly, since surgeons have done away with the injurious influence of antiseptics on the remaining kidney by employing an aseptic technique, and in looking back we can see that in many cases where anuria occurred immediately after the removal of a kidney, it was frequently due to the absorption of toxic products employed for sterilization. It becomes evident at the present time, when functional disturbances occur in the remaining kidney after nephrectomy, that in the majority of cases the process is purely a physiological one, due to a reflex condition acting on the innervation of the renal vessels.

In cases of obstruction of one ureter other than from calculus, the easiest and clearest reason for the occurrence of a reflex suppression of secretion, giving rise to a so-called sympathetic anuria, is met with when acute suppression arises in movable kidney. In these cases, at the time of the attack, a decrease in the amount of urine, or even absolute anuria may occur. When the crisis is over the renal function is restored, so that any supposition of any arrest of the secreting functions having preëxisted in the other kidney must be rejected. Israel has reported a case where this fact cannot be denied, in which he observed a distinct reflex inhibitory influence over the left kidney arising after an acute increase in tension, resulting from a temporary closure of the ureter in a right-sided hydro-nephrosis.

The kidney was enormously distended from time to time

and extremely painful from the tension and, at the time of the attacks, the amount of urine secreted diminished to practically nothing, but as soon as the sac was emptied by puncture a flood of urine was voided by the bladder. This polyuria occurred from the healthy kidney, for the urine voided by the bladder was perfectly normal, whereas that obtained from the hydronephrosis was tinged with blood. In another case Israel was dealing with an increase in intrarenal pressure in one kidney, resulting from bending of an abnormally long ureter, and a suppression of the secretion in the healthy kidney resulted. The occlusion of a left-sided hydronephrosis resulted in a total anuria. The right kidney was incised and during the operation the renal vein was ruptured, death resulting 28 hours after the operation. Microscopic examination showed that the structure of the right kidney was perfectly normal.

According to these observations it becomes evident how an irritation arising in one kidney can suppress the secreting functions in the opposite organ and by removal of the exciting cause the normal kidney will again regain its physiological functions. A still more evident proof, possessing the positiveness of a physiological experiment, is the occurrence of a renorenal reflex resulting in oliguria or anuria when the latter condition is overcome after removal of the diseased kidney during the occurrence of occlusion to the exit of the urine from that side. Here again Israel has reported an interesting case. He removed a diseased kidney, and after the operation the amount of urine voided in 24 hours amounted to three times the quantity expelled before the operation. Here one is dealing with instances of bending of the ureter and hydronephrosis resulting in an increased intrarenal pressure, which by reflex action stopped the excretory function in the opposite gland.

Considering those cases of obstruction due to impaction of a calculus in the ureter on one side and where anuria results, it is difficult to prove the sympathetic nature of the condition. It may be upheld that one ureter is occluded by a calculus,

while the ureter of its fellow may be bent, or the opposite kidney may be diseased and incapable of carrying on its function, or that it may be a rudimentary organ, so that the occluded kidney was in reality the only one carrying out urinary secretion. It is quite true that such conditions have been frequently observed and reported as instances of reflex anuria, but, nevertheless, there are enough authentic recorded cases to be found in which an occlusion by a calculus in one ureter has distinctly resulted in a reflex action arresting the functions in the opposite healthy kidney. Legueu is very positive in asserting that there is no such thing as reflex anuria, and when suppression of the urine does occur, it is due to the fact that the patient possesses only one kidney. Personally, I believe that this opinion is too absolute, and a case recorded by Israel seems to show that the proposition is untenable in every case. After exposing the left kidney and removing a stone from the hilum in a patient 62 years old, Israel noted that the urinary secretion returned immediately and very profusely, both by way of the bladder and through the drainage-tube in the left kidney. By the cystoscope it was found that the right kidney, which had not been operated on secreted normally again, which would seem to prove the reflex nature of the cessation of its function. Legueu, nevertheless, upholds that a reflex calculous anuria cannot exist, and when there is anuria from calculous obstruction, both kidneys must be diseased or only one gland is present. The above-mentioned case, reported by Israel, would seem, however, to prove the contrary, because complete anuria was present with obstruction in one ureter only, which was completely relieved after operation and proved by the cystoscope that urine came into the bladder from the healthy kidney after operation. The following case is interesting in many respects:

A male, 37 years old, with a good family history, had never been ill. Up to within six weeks of the time the patient was first seen there apparently had not been any renal symptoms. The

patient, however, became suddenly ill with pain in both renal regions accompanied by anorexia and abdominal distension. Since the commencement of the illness the urine appears to have shown a considerable deposit and, at the same time, the amount was markedly decreased.

After judicious medical treatment had been resorted to for several weeks, the urine continued to be passed in very small amounts, was decidedly cloudy and contained a fairly large amount of albumen. A few days before coming under observation the amount of urine excreted became less and less until complete anuria resulted. Up to this time the patient's general condition was fairly good and he did not suffer, but, in order to prevent the appearance of uremic symptoms, he was placed under surgical observation.

When first seen the anuria had been present for a day and a-half. Physical examination showed a large, well-built man, with slight œdema of the feet. The mental condition is not changed other than for some slight confusion. The pulse was weak and about 70 to the minute. The thoracic organs appeared normal and no intestinal symptoms were present. Palpation of the renal region elicited no more pain on the right than on the left, but he stated that the last attacks of pain had occurred on the left. Neither kidney could be palpated.

An operation was undertaken at once and since the patient complained of more pain on pressure over the left kidney, and as the kidney could be palpated on that side, as well as the objective diagnosis, this gland was presumed to be the one that had retained its functions up to the last. As to the condition of the right kidney, and whether or not it had become physiologically without value, was a problem that could not be solved. Likewise the etiology of the anuria could not be made out with any certainty, although a reflex calculous anuria, or obstruction of the ureters with calculi, was considered probable. The left kidney was consequently exposed and was found tumefied and hyperemic, but otherwise apparently normal. The renal pelvis was of normal size and the ureter, as far as it could be palpated, was normal. The kidney was then split open and a small amount of cloudy urine made its exit from the renal pelvis. Retrograde catheterization of the ureter revealed nothing, as the instrument could be

pushed into the bladder. The operation was completed by gauze plugging and a drainage-tube. The outcome was satisfactory, because, several hours after the operation, large amounts of urine came from the wound, but none from the bladder. This continued for ten days and then less urine was excreted through the tube, while the quantity expelled by the bladder increased. During convalescence the patient experienced attacks of pain in the right kidney and with each of these there was a decrease in the amount of urine passed. After eight days, the attacks of pain on the right ceased and did not return and, as the wound was closed and the patient felt perfectly well, he was discharged twenty-five days after the operation. We heard from him three months later, when he stated that he was in the best of health and the amount of urine passed was normal. Seven months after the operation he again complained of pain in the right renal region, but the amount of urine did not decrease, though it was found to contain a considerable amount of albumen. Upon examination the right renal region appeared tumefied, and upon incision a large amount of pus was let out, which surrounded the kidney, but the wound closed kindly in a short time.

From this it would appear that a calculus or calculi were present in the right kidney, and that a pyelonephritis had developed and resulted in a pararenal abscess by which the concretion had made its exit. A year later the patient was in excellent health.

A very similar case has been recorded by Mittag, which occurred in von Bramann's clinic, and another by Godlee. The latter case is briefly as follows:

A physician, 31 years of age, suffered from septicemia when a student in 1872, as a result of an injury; otherwise he had been well until the last two years, when he had occasional attacks of right-sided renal colic which were relieved by morphine. The attacks became more severe and associated with anuria, while the urine showed quite an amount of albumen and many hyalin casts. In July, 1885, a deep-seated perinephritic abscess was opened, but the kidney could not be discovered. No urine came from the wound, and the albumen considerably decreased. In December of the same year complete suppression

of urine again occurred, lasting a week. No operation was undertaken, because it was supposed that there was only one functioning kidney, whose ureter had been occluded by a calculus. Death took place a week later. Autopsy showed a large pus-pocket in the right kidney with a calculus lodged in the middle of the ureter, above which the tube had become greatly dilated. The left kidney was large and normal, and microscopically only showed evidences of a mild interstitial nephritis. The interesting points in this case are that an abscess in the right kidney could produce such a considerable amount of albumen and casts in the urine and that the irritation in the right renal gland could cause complete anuria, although the other organ was comparatively healthy. Godlee expressed the opinion, in reporting the case, that perhaps the amount of morphine given the patient had some bearing in the production of the anuria.

In a case occurring at the surgical clinic at Halle, a renal abscess on the right side was present, which at times gave rise to considerable albumen in the urine. Here again the irritative process arose in the diseased right kidney, producing anuria from its reflex effect on the secretion in the latter.

We now come to reflex anuria arising in traumatism of one kidney, and we will first consider direct traumatism. In traumatisms of the kidney, whether they be operative or not, anuria may arise, although the opposite gland may be normal. Marsh and Clark have met with such instances, although, under the circumstances, one is dealing with a combined action of various factors, which, according to the above-mentioned authorities results in a too complicated process to allow one to consider the condition as a reflex anuria with any certainty. On the other hand, other observers have reported cases which are more important. Butler has published the following case:

A laborer 43 years old received a blow on the left side of the abdomen, and, although the region pained him, he continued to work for four days. On the fourth day following the accident anuria suddenly occurred, accompanied by rigors, nausea and violent pain in the back. When seen on the tenth day after anuria had set in, his breath possessed a distinctly urinous odor and the abdomen was slightly distended. On the next day there was vomiting and muscular twitching during sleep, and two days later he died with all the symptoms of uremia. Autopsy showed a cystic atrophic kidney with a patent ureter.

The left kidney was considerably enlarged and bound down by old and new adhesions. The ureter was distended with urine and at its middle was found a complete obliteration; in the radicles of the renal vein, thrombi were found, which at first sight looked like small calculi.

After removal of one kidney anuria may follow, and if the condition is not overcome death soon results from uremia. Anuria arises under these conditions, either from the fact that the opposite kidney was diseased to such an extent that its functions had been carried out altogether by the organ removed, or, on the other hand, the heart may have been undergoing a pathologic transformation for some time and its action becomes weakened from the narcosis and loss of blood which accompany all operative interferences. In the latter case, from the poor blood supply ischemia of the kidney results, causing rapid degeneration of the renal epithelium and, with this, cessation of its functions. Without any doubt disturbances in the kidney occur, which, in some cases, are rapidly overcome, while in others an acute inflammatory process arises, resulting in a diminution of the secretion, which finally ceases. Autopsies on these cases show either an extreme cloudy or fatty degeneration with necrobiosis of the renal epithelium, or the kidney may present an interstitial infiltration in which the renal epithelium also tends to become considerably involved. In the milder cases a reflex action in the healthy kidney is the result of the anuria, but in other instances other influences, probably of a purely nervous nature, are to be taken into consideration, which are evidently direct irritations far exceeding the physiological point. It is not possible for a perfectly healthy kidney to fail under the burden suddenly imposed upon it by the removal of its fellow, so that one should search for some other influences of specific irritation. Bonardi has shown experimentally that in animals from whom a kidney has been removed under narcosis, the subjects were more susceptible to infections and intoxications. A very serious influence upon the renal epithelium resulting from the narcotic used, whether in the form of a direct irritation, or ischæmia resulting from

the narcosis, is most doubtful. One should always take into consideration the absorption of chloroform into the system which, in itself is not dangerous, but combined with other influences is apt to increase the danger.

Certain antiseptic materials when coming into direct contact with a wounded surface in large quantities, are far more important than either ether or chloroform. The deleterious action on the kidney of carbolic acid, iodoform, and especially bichloride of mercury, is well known, and if into the bargain the heart's action becomes weak, a condition not infrequently observed in doing nephrectomy, the danger then increases to a considerable degree. For this reason I am of the opinion that in the removal of a kidney the aseptic technique is the one to be preferred.

In this respect an interesting case of anuria following removal of the kidney, occurring in the surgical clinic of Marburg, has been reported by Barth. The case was a malignant tumor of the right kidney in a five-year-old child. The decreased amount of urine existing before the operation did not at first undergo any considerable change after the kidney had been removed, and the amount excreted even began to increase. The patient convalesced and appeared out of danger, when, on the fourteenth day, he was nauseated and sleepy, while the amount of urine rapidly diminished, only 40 grams being passed on the next day, which contained albumen and large numbers of red blood-cells. On the day following complete anuria set in, with marked uræmic symptoms. The pulse was irregular and intermittent. On the following day the condition suddenly changed; the urine was secreted to an amount not reached before, the pulse became regular, and all the alarming symptoms disappeared, and from this time on the patient rapidly recovered. The remaining kidney was not enlarged, nor painful, the chemical and microscopic changes in the urine were only present during the attack, and examination of the bladder showed it to be perfectly normal.

To sum up, it may be said that this was a reflex anuria, probably arising from irritation of the nerves in the stump of the removed right kidney and this caused a reflex angiospasm in the vessels of the left organ, resulting in the cessation of the secretion. The irritation producing a reflex was probably due to an inflammatory swelling of the granulating wound in which

the nerves were imbedded. The change in the heart's action should also be taken into consideration in this case. The pulse was very irregular and markedly intermittent during the attack, a condition of affairs not observed either before or after the attack. This phenomenon may, however, be explained when one takes into consideration the intimate and direct relationship existing between the vagus and the vasoconstrictors of the kidneys, as has been demonstrated by Masius.

Israel has recorded several cases of anuria following extirpation of the kidney, but he says that although complete anuria occurred, it was not the result of reflex influences, but wholly dependent on the weakened condition of the heart. This authority is skeptical regarding reflex anuria, although he does not consider it impossible and, according to his way of thinking, so many conditions are present during an operation that it would be difficult to consider the anuria following as due to any one particular cause. In his own cases the patients presented atrophic or parenchymatous changes in the myocardium and from the narcosis, the operative traumatism, and so forth, the heart, already in a diseased condition, was influenced in such a way that the renal activity would become lowered as the result of diminished blood-pressure. In point of fact, the latter is certainly of great importance, whether resulting from a weak heart or a reflex vasoconstricting action on the renal vessels. From the development of ischemia, if it persists for any length of time, severe damage to the renal epithelium results, but it can recover if the blood-supply is not interfered with for too long a time. An increase in the secretion of urine then follows, and the fact is clinically of great interest, because, to a certain extent, it represents a physiological reaction of the renal blood-supply, or rather, perhaps, its nervous apparatus, upon the preëxisting condition of irritation. An angioparesis of short duration follows angiospasm and, as in animal experiments, results in an abnormal secretion of urine. Clinically, this phenomenon is a very well-known occurrence.

The following case is not devoid of interest. A male, 41 years of age, was seen in the middle of January, 1900, complaining of a fulness in the bladder even when the organ was empty. Five days later a swelling was found just below the region of the stomach, with borders which could not be distinctly defined. Considerable pain was elicited in the tumor upon pressure. The patient complained of pains in the legs and back. The descending colon was found lying over the tumor, which extended from the left renal region down into the pelvis. Inflation of the stomach caused the resistance to disappear. The surface of the tumor appeared smooth. The growth increased in size very rapidly, so that by the first of February the patient was extremely weak and œdema of the lower extremities appeared. At no time were either albumen or casts found in the urine, but, on February 10, a trace was discovered and the specific gravity 1.004. The daily amount had averaged about 1300 grams, when suddenly on February 11 the urine decreased, only about 650 c.c. was voided, and the next day a little less. On February 14 complete anuria arose. When seen in consultation on this date, the patient was found extremely emaciated, with considerable œdema of the lower limbs. The tumor presented in the left hypochondriac region in the form of a hard swelling with a smooth surface and not adherent to the abdominal wall. The growth reached nearly to the median line, and its lower borders appeared to be about two fingers' breadth below the umbilicus. It was not movable. The growth in the abdomen might be roughly estimated as the size of an adult head. No fluctuation could be elicited. No functional disturbances of the stomach or intestine. By inflation of the large intestine the descending colon appeared to be displaced towards the middle line and somewhat downwards. The thoracic organs showed no evidence of disease.

Hydronephrosis was eliminated on account of the absence of fluctuation, but, although there was little or no rise in temperature, I did not feel that renal tuberculosis could be eliminated, although I was under the impression that I was more likely dealing with a sarcoma of the left kidney. But it might be either of the two latter diseases which had resulted in anuria, produced by pressure of the ureter from metastases in the mesenteric lymph-nodes on the right with displacement of the left ureter from direct

pressure, or, on the other hand, the anuria might be due to retention from compression of the right ureter from growths developing in the small pelvis. The marked œdema could be best explained from congestion due to compression on the inferior vena cava.

For the next few days that the patient was under observation there was complete anuria, proven by catheterization. The œdema increased, the patient complained of headache, and was constantly nauseated. The pulse ran high and, on account of the threatening uræmia, it was decided to operate. The right kidney was selected as the organ to be operated on, because it was practically certain that it was the healthy organ. Consequently the kidney was exposed by a lumbar incision and split open. The renal pelvis was found somewhat enlarged. The opening in the kidney was packed with gauze. For the next few days large quantities of urine were passed by the drain, it being somewhat cloudy and containing some epithelium presenting characteristics of fatty degeneration. A little urine was also voided from the bladder. The amount of urine coming from the wound and from the bladder varied and when a small amount was passed by the tubes the amount in twenty-four hours practically was equalled by the amount passed from the bladder. After the operation the patient's condition varied; at times his mind was clear, the appetite good and the tongue moist, while at others he was confused, vomited, and was persuaded with difficulty to take nourishment. He finally sank, and died nine days afterwards. Unfortunately no autopsy could be obtained.

Although more proof is not necessary to show that a renorenal reflex can result in the cessation of function of the kidney on the opposite side, I nevertheless would briefly allude to one case recorded by Israel, that of a young woman who, after removal of a right-sided hydronephritic kidney, presented reflex anuria due to irritation of the drainage-tube on the opposite side, which was too long. That this was so, is proven from the fact that immediately after the drainage-tube was shortened the amount of urine immediately increased to 3,000 cm. and, after this polyuria had lasted for several days, the urinary secretion returned to the normal.

In anuria due to cholera one finds, according to Rosenstein, a marked venous hyperæmia of the kidney, the organ being occasionally enlarged. Microscopically, casting off and degeneration of the epithelium is noted, although there appears to be an anatomical integrity of the secretory apparatus. The glomeruli of Malpighi, tubules and capsule, as well as the interstitial tissue, appear to be intact. Since the amount of urine voided depends, according to Ludwig and Heidenhain, upon the blood-pressure, and the rapidity of the flow in the glomeruli, the anuria occurring in the asphyxic stage of cholera is to be explained from this fact, because, in this stage of the disease, the pulse can hardly be felt, and consequently the circulation practically entirely ceases.

In the commencement of diffuse nephritis there is usually oliguria, so that the amount of urine in most cases will hardly exceed one hundred c.cm. In severe cases anuria may develop and last for one or several days. At the commencement of convalescence the 24-hour amount of urine appears increased and polyuria is not infrequently present. The anuria and oliguria appear to find an explanation through the almost complete blocking up of the urinary canals with casts. Whitelaw describes a case of anuria in a boy eight years old which lasted 25 days, commencing two months after the development of a scarlatina. Exceptional cases, however, occur where the connection between a diffuse nephritis and anuria is not at all clear, in which the suppression of urine suddenly occurs without any previous symptoms of any inflammatory process, and it is only operation or autopsy that reveals the correct condition of affairs. Such a case has been recorded by Israel, where a diffuse nephritis of both glands resulted in complete arrest in secretion of urine. As the anuria arose suddenly without any premonitory symptoms and without any qualitative or quantitative change in the urine, it was impossible to make a diagnosis beforehand.

It is well known that in cases of diffuse nephritis, especially when following scarlet fever, oliguria occurs, but

absolute anuria is uncommon. However, anuria is far more infrequent in ascending pyelonephritis than in hematogenous nephritis, for the simple reason that in the former the renal changes are not diffusely spread and exist rather more in the form of foci. Israel, however, has met with complete anuria in a case of left-sided sub-acute ascending pyelonephritis in a patient whose right kidney had been removed eight months previously on account of tuberculosis of the organ. The arrest of secretion is probably to be considered as a result of the acute inflammatory process with increased intrarenal pressure and from this results a sudden increase in tension, which explains the initial attacks of pain which may readily lead the clinician to make a diagnosis of occlusion from calculus. By slitting open the kidney the excessive pressure on the parenchyma can be relieved, because the blood, tissue-fluids and inflammatory products can be eliminated, and circulation is restored throughout the organ.

I now come to consider the most frequent cause of anuria, namely, renal calculus. Complete suppression of urine can more readily be understood in those cases where occlusion of both ureters occurs at the same time, or where only one functioning kidney is present. I have already mentioned how a failure in the functions of the second kidney, although perfectly capable of functioning, may arise when the ureter on the other side is obstructed, this being the result of a reflex vasoconstrictor type. Nephrolithiasis is more apt to make itself known after the thirtieth year of life, and generally only gravel and small calculi are voided. However, as these patients advance in years, the calculi from the kidney become larger in size, so that they cannot be expelled by the ureter. Now, if a patient presenting anuria has suffered for a number of years with renal symptoms, and if the passage of the stones has been painful, one should be on the lookout for hydronephrosis. During anuria calculosa, a hydronephrosis would hardly be formed, because the occlusion takes place suddenly, but only for a short time will the kidney secrete a small amount of urine.

Cohnheim was, I believe, the first to experimentally develop hydronephrosis, and he came to the conclusion that in complete obstruction of the ureter hydronephrosis can only occur to a mild degree, because the enormous tension set up rapidly produces a failure in the secretory power of the organ, and that very large hydronephrosis arises only in incomplete obstruction of the ureter. Clinically speaking, three possibilities may exist as far as the development of calculous anuria is concerned: either both kidneys with perfect functional integrity are arrested in their secretion from a calculus becoming lodged in the ureter, the same thing occurring in the other very shortly afterwards, or what is more uncommon, at the same time; secondly, we may have one kidney which is physiologically worthless on account of previous lesions and the only one that is carrying out the work becomes clogged by occlusion of its ureter; and lastly, we have those cases where the patient has only one kidney, the other having been removed for some lesion, or is congenitally absent.

Considering the case of two kidneys in perfect functional order, whose ureters have both become obstructed by a calculus, I am only aware of one recorded case, due to Haebner. That occlusion of both ureters must have occurred at about the same time, or within a very short interval, was shown from the fact that the mucosa at the points where the calculi were wedged in presented ecchymosis and the commencement of an ulcerative process, while the parenchyma of both kidneys gave evidences of the same condition. It is quite true that there are a number of instances of calculous obstruction in both ureters, in all of them one kidney was always functionally worthless on account of some former lesion. In these cases reflex anuria does not exist, but they were frequently classified under this heading, on account of superficial observation of the case. Bischoff has published a case of anuria which lasted 23 days, where both ureters were occluded by calculi, but the right kidney had not been functionally active for a number of years. Several instances of calculous anuria have been recorded by Israel, but they differ in no way from the others.

One is always dealing with the mechanical form of anuria, one where one kidney has been diseased for some time and occlusion of the functioning organ naturally leads to suppression of urine. Thus in Arlowski's case, which resulted in death from anuria of 18 days' duration, both glands had become physiologically worthless on account of the calculi; while in Ultzmann's case, in which anuria of 14 days' duration terminated fatally, the right kidney was found obliterated, while the left was double the normal size and a stone was found lodged in the ureter. The literature of all countries is replete with such cases. The following case is especially interesting for the reason that the function of the left kidney was suddenly overcome by occlusion of its ureter with a calculus, while the right kidney had apparently lost its functional powers some time past; these were regained, however, just at the time when an operation was about to be undertaken for the relief of the condition. The patient had frequently had attacks of pain on the right, followed by the passage of calculi, so that it could be reasonably supposed that the right kidney was already diseased. Then renal colic occurred on the left side. Anuria appeared, which lasted for nine days, so that it was decided to operate, but while being prepared for the operation, the patient suddenly began to pass urine and two days later a calculus, the size of a pea, was voided.

The third possibility for the occurrence of calculus anuria, aside from reflex anuria, is where only one kidney exists. It is true that, so far as I am aware, only two instances of anuria arising after the removal of one kidney have been encountered. The first case occurred in the practice of Dr. Lewis S. Pilcher, to whose courtesy I am greatly indebted for the privilege of reporting this case, which has not as yet been published, while the second, met with by Dr. F. Kammerer, is recorded in this issue of the *ANNALS OF SURGERY* (page 113).

A male, 32 years of age, was admitted to the Methodist Episcopal Hospital in Brooklyn, N. Y., on October 8, 1905, with a history that in December, 1902, after an uncertain period of

previous symptoms, he had been subjected to a nephrolithotomy of the left kidney by Dr. A. T. Bristow at the King's County Hospital. A fistula persisted after this operation, in consequence of which he was again admitted to the same hospital in July, 1904, in the service of Dr. William Maddren, by whom a complete extirpation of the left kidney was done. From this operation he made a good recovery, with complete healing of the operative wound. He remained well thereafter until September 1, 1905, when he began to complain of pain in the region of the remaining right kidney. This had persisted with remissions and exacerbations for five weeks, during which time he was under medical treatment, but without relief.

On the evening of October 8 the pain suddenly became very severe, and was attended with vomiting and a rise in temperature. On account of this attack he was brought to the Methodist Episcopal Hospital for treatment, with the statement that no urine had been passed since the attack began. Examination revealed rigidity of the abdominal muscles in the right hypochondriac region; tenderness on pressure in the right lumbar region, where an enlarged right kidney was palpable. Temperature 101.6° ; pulse 120; respiration 40. Blood examination: white blood-corpuses 19,400, polynuclear leucocytes 87 per cent. Nine hours after admission, having passed no urine during this time, he was catheterized and less than a half teaspoonful of urine was obtained from the bladder. Twelve hours after admission the right kidney was exposed by a lumbar incision. It was found swollen, congested and œdematous. The renal pelvis was much distended, and when incised several ounces of urine gushed from the opening under great tension. Some pus was mingled with the urine. Through the opening in the renal pelvis twenty-three calculi, varying in size from that of a split pea to a hickory-nut, were then removed and the interior of the cavities in the kidney was thoroughly irrigated. A sound was passed down into the ureter, which was found patent. The outlet from the pelvis of the kidney had evidently been blocked by one of the calculi which had been removed. A rubber drain-tube was inserted down into the renal pelvis and the incision in the latter was closed by chromic gut down to the tube. The greater portion of the operative incision was closed by sutures, a moderate tampon of iodoform

gauze being placed around the tube from skin to kidney. For the first twenty-four hours after the operation the discharges from the wound were very slightly urinous in odor and no urine passed down into the bladder, as ascertained by the passage of the catheter. Nitroglycerin and an abundant ingestion of fluids were then prescribed. During the second twenty-four hours, 105 ounces of urine were voided from the bladder. From this time the function of the kidney and bladder continued normal. The drainage-tube gave issue to a light amount of urine during the first ten days. On the fourteenth day the drainage-tube was discontinued, after which the sinus rapidly closed. The patient made an uneventful convalescence and was discharged cured at the end of five weeks from his admission.

A case of anuria has been reported by Meyer which occurred thirty-eight days after nephrectomy and was due to obstruction of the ureter by clots and pus. Nephrotomy was performed successfully. During life it is hardly possible to make a diagnosis of the presence of only one kidney, and it is usually at autopsy that this is discovered. In this respect I would mention Schwenger's case. The patient had always been well up to the time of an anuria which lasted nine days. This was ushered in with severe pain on the right side and death resulted. Autopsy revealed the absence of the left kidney, not even a rudimentary organ being found. Occlusion by a calculus lodged in the ureter was the cause of the anuria.

The diagnosis of calculous anuria can ordinarily be made from the history of the case, because these patients generally have been previously troubled by urinary symptoms, such as the passage of gravel or a calculus. Colicky pains and blood in the urine precede in many cases the passage of a stone, but, on the other hand, every symptom may be lacking, the anuria suddenly occurring without any warning. Now, since anuria is not an infrequent symptom of nephrolithiasis, this condition should be first considered, but some difficulty may be encountered in those cases where the patient gives no distinct history of past trouble. However, the first thing that comes

to one's mind is whether or not a calculous obstruction exists in both ureters, or only in one, and, if the latter, upon which side? Then, if it is ascertained that both ureters are obstructed, it is most important to determine which kidney was the last affected, because when the functioning kidney becomes the object of operation, the outlook is good if the obstruction can be removed, as the other kidney may have been physiologically worthless for some time. In order to come to a correct conclusion the history given by the patient himself will greatly help, because he will probably be able to give information as to the side he first felt the pain in. When the answers relative to pain are definite, one should always bear in mind the possibility that the last pains felt may have been in the diseased kidney, due to a renorenal reflex, and this has been shown in a case reported by Israel. The objective findings are hardly worth considering, for even if by purely objective diagnosis the other kidney is found diseased, it still remains questionable whether it is the cause of the anuria and perhaps functionally worthless for a considerable length of time, and whether or not if the remaining functioning kidney were attacked by operation it would relieve the anuria. The pain resulting from pressure on the obstructed side is not of much value, but Israel considers as a valuable symptom a marked rigidity of the abdominal walls on palpation, which occurs on the side where the kidney was last occluded. As to the value of catheterization of the ureters, opinions vary. As this can only be done with a very fine and rather soft bougie, there is a question whether or not the instrument would allow one to recognize the presence of a calculus when it came in contact with it, because the instrument may become caught in a fold of the mucous membrane of the ureter which is swollen and inflamed, or it may be grasped by a spasm of the ureter. However, if a stone should be diagnosticated, the kidney may have been destroyed for some time and the obstruction may have been present for many years, while the remaining kidney has only become physiologically involved recently. Now, supposing a

stone should be detected in the ureter of the latter, it is questionable whether the obstructing calculus is not located in the ostium of the renal pelvis. The passage would consequently then be free and the only infallible sign is when no urine is seen by the cystoscope making its exit from the ureteral orifice. Of equally little value is radioscopy, because the stone is not always made evident. Consequently one may say that the kidney to be operated on is the one which was the seat of the last pain, or when this cannot be ascertained with certainty, then one should operate on the gland which, on palpation, gives rise to the greatest pain, or on the side where the greatest reflex rigidity of the abdominal walls is found.

As to the time when the operation should be undertaken, it at once becomes evident in looking over the reported cases that the result of the operation depends entirely upon this factor. Israel advises not waiting longer than forty-eight hours if the obstruction is not removed after this time, and statistics plead in favor of a timely interference. Legueu showed, in 1891, that the number of cures of calculous anuria where operation was undertaken amount to 66.6 per cent., while in those left alone only 28.5 per cent. recovered. Other French authorities opine for early interference.

When Tuffier introduced nephrotomy, in 1890, surgeons began to attack all renal calculi and those situated in the upper part of the ureter by splitting open the kidney, and personally I feel prepared to say that when the obstacle in the ureter cannot be removed, the kidney should always be opened in order to give exit to the urine.

Relative to those cases of anuria whose cause is due to ureteral obstruction from blood-clot or compression from without, it may be said that they are rare, and it is probable under these circumstances that the other kidney is functionally destroyed. Some years ago I treated the question of anuria resulting from extension of carcinoma of the uterus in a paper published in the *Boston Medical and Surgical Journal*, so I will not refer to it here. Anuria is certainly very rare as the

result of compression of the ureter, but Farlow reported a case in the above-mentioned journal in 1889, where death occurred in twelve days. The patient was a woman thirty-five years of age and autopsy revealed a firm, fibrous mass inclosing the walls of the ureter. The ureters and renal pelves were considerably dilated. Patel remarks, in considering anuria resulting from compression of the ureters by abdominal tumors, that both ureters are really obstructed at the same time. Now, if anuria occurs it must be that both kidneys are diseased or that the kidney whose ureter is free has been deprived of its physiological functions by reflex action. He regards the explanation given in those cases which have been reported as unsatisfactory and believes that only the first theory is correct, basing his assertion on a thoroughly-observed case occurring in Poncet's clinic.

In closing this paper I cannot refrain from recording one case of anuria of puerperal origin, and where I feel quite certain that had I done a nephrotomy the patient might possibly have been saved. As it was, bilateral decapsulation was done and although some improvement manifested itself, the patient died four days after the operation. The history of the case is briefly as follows:

A young woman, 26 years of age, was delivered on a Saturday evening, the labor requiring only the application of the low forceps. Everything was perfectly normal until at noon on the Thursday following the patient was taken with a rigor and the temperature immediately rose to about 39.5° C., the pulse following it proportionately. The attending physician rightly suspecting that some uterine infection was showing itself, immediately resorted to intra-uterine irrigations. On the same evening the patient, who had voided no urine during the day, was catheterized and the bladder found empty.

After the irrigation the temperature did not go up and the pulse returned to nearly normal, but from this time on complete anuria existed. I saw the patient in consultation on Sunday morning,—*i. e.*, after the anuria had been present for about 60

hours, and made the following notes: Mind perfectly clear; pupils normal; tongue moist but furred. Pulse 80, temperature normal. Bimanual examination revealed nothing abnormal in the genital apparatus. There was no œdema other than a slight puffiness under the eyes.

The patient was immediately removed to a private hospital, where a radical treatment to combat the suppression of urine was immediately undertaken, consisting of hot packs, pilocarpin subcutaneously, and acetate of potash internally, with a milk diet. This treatment was carried out for 48 hours without attaining any result, and not a drop of urine could at any time be obtained from the bladder. On the next day the œdema of the face became more marked, and also appeared at the ankles, while the pulse increased in rapidity and was of a wiry nature. On Tuesday morning,—that is to say, five days and a-half since the commencement of the anuria, the condition was the same, but the œdema had become more marked so that operation was immediately decided upon. Narcosis with ethyl chloride and ether. Bilateral decapsulation was done at one sitting, my assistant, Dr. Rolfe, doing one kidney, while I did the other. The glands were exposed by transverse incision, and were found greatly enlarged, tense and extremely hyperæmic. Decortication was rapidly accomplished, as the kidney popped from its capsule like a pea from a pod. Capsules were resected, the kidneys dropped back and the wounds sutured. Duration of the operation thirteen minutes.

During the next twenty-four hours the patient voided 270 c.c. of very albuminous urine containing casts; in the next twenty-four hours 300 c.c. were voided, but during the next twenty-four suppression again became complete, the œdema markedly increased, the mouth became dry, and the patient was delirious. She died sixteen hours later.

The autopsy revealed absolutely nothing abnormal in the abdominal viscera and microscopical examination of the kidneys showed that we were dealing with an acute parenchymatous nephritis, as had been diagnosed clinically.

RETROPERITONEAL PERIRENAL LIPOMATA.

A STUDY OF LARGE RETROPERITONEAL LIPOMATA OF PERIRENAL ORIGIN. THE TECHNIQUE OF THEIR REMOVAL, BASED ON ANATOMICAL STUDIES, WITH THE REPORT OF A CASE.

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RETROPERITONEAL LIPOMATA are tumors which usually attain a very large size before being called to the attention of the surgeon. They are often of obscure origin, though the majority probably arise from the perirenal fat. They are so rare that it seldom happens that any surgeon sees more than one, and it is probably for this reason that no definite technical principles for their removal have been evolved and recognized. This fact, together with the high mortality hitherto incurred, makes it important that every case should be carefully studied and reported in detail. This is the more important as it is probable that the absence of a recognized technique has been responsible for the not infrequent cases of incomplete removal. Several surgeons have recognized the advantages of an attack by enucleation from within the capsule, which was the method that led to success in the case to be reported; no one, however, has made any attempt to describe the relations of the capsule to the anatomical dangers within and without it, or to lay down guides for their avoidance.

It is a belief in the importance of attaining definite knowledge on this subject that has led us to the anatomical study of these relations which is the basis of this article.

Adami in 1897 collected 42 cases of retroperitoneal lipoma in the literature and classified them according to origin, making three classes, viz: (1) Those definitely perirenal, (2) those of doubtful origin, and (3) those arising from the mesenteric

fat. The most recent, comprehensive article on this subject which we have been able to find was published by Johnson in 1904. He considered 24 of Adami's cases to be of perirenal origin and thought that probably many of the doubtful cases also belonged in this class, so that it may perhaps be considered that rather more than fifty per cent. of retroperitoneal lipomata arise from the perirenal fat. He was able in 1904 to collect only 46 cases in the literature, and at that time reported two more of his own, which with the case reported here brings the total up to 49.¹ That these growths are essentially benign is shown by the fact that in only three of these cases has sarcomatous degeneration been found, and that the growth has recurred after removal in only one case. They must, therefore, be considered as distinct from retroperitoneal sarcomata, which may, however, present a very similar clinical picture.

The symptoms connected with these growths are chiefly conspicuous by their absence. Usually the first symptom is a feeling of weight in the abdomen with some gastric irritability. As the tumor grows the symptoms are those of pressure, such as alternate constipation and diarrhœa accompanied by vomiting, dyspnœa, œdema and ascites from venous obstruction, and occasionally neuralgic pains in the legs from pressure on the lumbar plexus. But it is extraordinary how often only trifling symptoms are present, even when the tumor has reached a very large size.

The diagnosis is made by the lack of mobility, the smooth rounded surface, and the semi-fluctuant sensation imparted by the fat, aided occasionally by the stripe of tympany in the middle of the flatness over the rest of the tumor which is made by the overlying colon when that is distended; but the diagnosis has been very infrequently made, the tumor being most often mistaken for an ovarian cyst. Other mistaken diagnoses have been those of mesenteric and retroperitoneal cysts,

¹ Since this was written Dr. Ahren, of Quebec, has reported a case (*Bull. Med. de Quebec* 1905-6, vii, pp. 1-6), making a total of fifty cases reported and known to us.

echinococcus cyst of the liver, hydronephrosis, and even ascites.

The treatment is necessarily operative. Of the 49 cases reported, 31 have been operated on, with a mortality of 48.4 per cent., one recurrence increasing the mortality to 51.6 per cent., the remainder having been seen post mortem. An analysis of the cause of this very high operative mortality strongly emphasizes the desirability of an accurate anatomical knowledge of the conditions which are likely to be encountered.

The three dangers of the operation as deduced from the fatal cases are: accidental injury of the mesenteric vessels, necessitating resection of the bowel; accidental injury of the vena cava or its other branches; and death from shock, which must be greatly influenced by slow operating or the time necessarily spent in the repair of such accidental injuries, all of which would be minimized by a more accurate knowledge of the anatomy of the tumor, and by this only.

In the course of this case and in subsequent conversation about it, it became evident to us, first, that its success had rested upon following the inner surface of the capsule as a guide, and, second, that this capsule was the distended perirenal fascia. This perirenal fascia has been described repeatedly in the last few years, but always in connection with its function of contributing to the support of the kidneys through its limitation of the perirenal fat. In these dissections no study of its relations to the vessels and viscera in contact with its outer surface was reported, but these relations are the essential anatomical points in the removal of these tumors, and this was the reason for our institution of fresh dissections.

Although our present knowledge of the perirenal fascia is founded really on the work of Gerota in 1895, the existence of a fascial capsule about the perirenal fat had been recognized by many investigators before that time and with gradually increasing clearness of description.

In 1883 Zuckerkandl described a well-marked fascia lying between the quadratus lumborum muscle and the fatty capsule of the kidney. This he considered to be the continuation of the

subperitoneal fascia of the anterior and lateral abdominal wall. Tracing it inward he described it as becoming attached to the capsule of the kidney at its inner margin. In front of the kidney he recognized a thin fascial layer between the perirenal fat and the parietal peritoneum, which in some subjects was condensed to such an extent as to form a distinct lamella of some density. In 1889 Sappey, while recognizing the posterior layer as Zuckerkandl had described it, gave more importance to the anterior layer, which according to his investigations extended inward to become attached to the inner border of the kidney. A year later Charpy described an offshoot from this anterior layer at its attachment to the hilus of the kidney, which passed across the middle line immediately in front of the renal vessels, aorta, and vena cava to join its fellow of the other side. The retrorenal and prerenal layers were at this time described as uniting at the upper pole of the kidney, thus separating the suprarenal capsule from the kidney.

With Gerota's work, however, our knowledge of the fascia becomes more exact. In 1895 he published the results of a protracted study of this whole region by means of micro- and macroscopical examination of sections of embryos, infants and adults. His description of the perirenal fascia is as follows:

The prerenal and retrorenal layers are formed by the splitting of the subperitoneal fascia of the abdominal wall at the outer border of the kidney.

The retrorenal layer passes inward between the perirenal fat in front and the fascia covering the anterior surfaces of the quadratus lumborum muscle and its aponeurosis and the psoas magnus muscle behind. At the inner border of the psoas magnus it blends with the fascia covering the bodies of the lumbar vertebræ and the intervertebral disks.

The anterior or prerenal layer passes in front of the perirenal fat between it and the peritoneum and is continued inward just in front of the renal vessels, aorta, and vena cava to join the corresponding layer of the other side. Both the anterior and posterior layers are attached to the kidney capsule

by fine fibrous bands which pass through the perirenal fat, but the fasciæ as such have no direct attachment to the kidney. The retrorenal layer extends upward in front of the diaphragm and behind the kidney and suprarenal capsule, at the upper border of which it is joined by the prerenal layer from in front of them, the two becoming lost in the diaphragm. Below the kidney the two layers approach each other but do not actually join and, becoming thinner and thinner, are lost in the loose areolar tissue of the iliac fossa.

This fascia of Gerota, then, forms a fascial compartment, closed above and externally, but open below and internally, in which is contained the kidney and suprarenal capsule and the perirenal fat. This compartment we shall refer to hereafter as the perirenal space.

As has been already said, the perirenal fascia has hitherto been studied only in connection with the supports of the kidney. Its relations to tumors arising from the perirenal fat has not been recognized and it is towards the elucidation of these relations that our own anatomical work has been especially directed.

This work (by Dr. Wadsworth) was made possible by the courtesy of Professor Dwight, who placed at our disposal all the material of the anatomical department of the Harvard Medical School. His kindly interest and many valuable suggestions have been of the greatest help.

Two sets of frozen sections of the adult abdomen were available, but both had been made several years before and had been more or less injured by much handling. In only one section was anything corresponding to the prerenal fascia made out. This consisted of a layer of tissue of some density lying between the parietal peritoneum and the perirenal fat on each side and continuous across the middle line just in front of the great vessels. This, however, could be traced only a short distance into the thickness of the section, and nothing corresponding to it could be found in the adjoining sections. A fresh set of adult sections could not be made, owing to lack of

material, and although a new-born infant was sectioned no trace of the perirenal fascia could be found.

The subjects which were available for dissection were being used by students in the regular anatomical courses, so that it was imperative that the abdominal contents should be as little disturbed as possible. It was, therefore, impossible to employ the method used by Koffman,—*i.e.*, the injection under the prerenal fascia of a material which would harden *in situ*. Similar injections of air and water were tried and proved ineffective, but satisfactory results were obtained by blunt dissection in the planes of cleavage with the finger and knife-handle. Three subjects were dissected in this way.

In each case an incision just large enough to admit the finger was made through the peritoneum overlying the left kidney and carried downward through the very scant perirenal fat to the fibrous capsule of the kidney, which was recognized by incising and stripping it from the kidney for a short distance. The kidney having been recognized in this way, the finger was withdrawn a little and gently pushed inward just in front of the perirenal fat. A distinct line of cleavage was at once recognized and was followed with very little difficulty to and beyond the median line, the finger passing immediately in front of, first, the anterior surface of the kidney and, second, the left renal vein as far as the vena cava. The tissues lifted away by this process consisted of two distinct layers, which could be made to move on each other when handled from within and without at the same time with the thumb and finger, the outer layer being the parietal peritoneum and the other the prerenal fascia.

Following the line of cleavage further to the right and across the median line, the finger passed behind the duodenum and then the ascending colon and immediately in front of the right renal vein and anterior surface of the right kidney. Here as on the left side, there were two distinct layers in front of the finger, the parietal peritoneum and the prerenal fascia. By separating these two layers from each other, it was seen that

the peritoneum passed over the anterior surface of the duodenum, while the prerenal fascia passed not only behind it but also behind the main trunk of the superior mesenteric artery, as it passed downward into the mesentery of the small intestine.

Carrying the dissection downward and outward from the original incision on the left side, the finger passed behind the descending colon. Here the peritoneum was seen to pass over the anterior surface of the colon, while the prerenal fascia lay behind it and appeared again in apposition with the peritoneum in the flank external to the colon. A similar arrangement was demonstrated on the right side in relation to the ascending colon.

Carrying the dissection inward from each side at and below the level of the lower part of the kidneys, the prerenal fascia was seen to extend across the middle line nearly as far downward as the bifurcation of the aorta, getting, however, thinner and thinner until it could be no longer made out. It thus passes directly behind the root of the mesentery of the small intestine, shutting off the mesentery and its vessels from the perirenal space.

The prerenal fascia was traced upward in front of the two kidneys only far enough to show that it passed across the base of the transverse mesocolon, thus shutting off this also from the perirenal space. In the middle line it was seen to pass beneath the pancreas, but was not traced further owing to the difficulty of seeing what one was doing, as nothing could be removed to make room. No attempt was made to trace the prerenal fascia to its lateral origin in the subperitoneal fascia of the abdominal wall, as this did not seem to be of particular importance to the object in hand.

To sum up the anatomy: The perirenal space, in which is contained the perirenal fat and to which a tumor growing from this fat must be limited, is bounded in front by the prerenal fascia, as just described, and behind by the retrorenal fascia described by Gerota.

The retrorenal fascia lies behind the perirenal fat, kidneys,

ureter, and renal vessels in direct apposition to the posterior abdominal wall on either side of the vertebral column. It therefore really forms a part of the posterior abdominal wall and is of no particular surgical importance.

The prerenal fascia, on the other hand, lies in front of the perirenal fat, kidneys, ureter, and renal vessels, and is of extreme surgical importance since it separates these organs from the other vital structures in the immediate neighborhood.

It is now important to consider the relations of this all-important prerenal fascia to the organs behind and in front of it; which are the intestines and their vessels in front, and the aorta, vena cava, and urinary organs behind it and therefore within the perirenal space.

The three parts of the colon, the entire small intestine, and the pancreas lies in close relation to the prerenal fascia, but outside it, and therefore are separated by it from the fat of the lipoma. An operation conducted within the perirenal space can therefore do no harm to the intestines unless by interference with their blood-vessels. The superior and inferior mesenteric arteries, which form their blood supply, are throughout their course also in front of the prerenal fascia except for a short distance after their origin from the aorta, when they must of necessity cross the perirenal space to penetrate the fascia. They are therefore liable to injury from an operation within the perirenal space only during the removal of the fat from the region of the aorta and vena cava in the median line.

The spermatic or ovarian vessels like the mesenteric arteries lie throughout their course in front of the prerenal fascia except for a short distance after their origin, when they too must pass through the perirenal space before piercing the fascia. They too are liable to injury only during the same portion of such an operation. The left ovarian (or spermatic) vein empties into the left renal and this must be remembered in dealing with the renal vessels.

The renal vessels extend in approximately straight lines between the kidneys and the aorta and vena cava. The kidney

necessarily lies in the middle of the perirenal fat and the renal vessels must therefore pass through the substance of these lipomata in order to reach their destination, but from the nature of the perirenal fat they must inevitably lie throughout between the lobules of the lipoma.

In the normal cadaver, the ureter lies throughout its abdominal course behind the prerenal fascia and within the perirenal space; immediately below the level of the kidney the prerenal and retrorenal layers lie close together with the ureter between them, but the ureter is more adherent to the prerenal than to the retrorenal fascia; the upper end of the ureter lies, however, between the lobules of the perirenal fat.

In the presence of a lipoma, it is evident that the upper end of the ureter must be completely surrounded by the substance of the growth. What the relations of the lower part of the ureter to the tumor will be cannot be foretold with accuracy, since they will probably vary in individual cases; from its closer attachment to the prerenal fascia it may, however, be stated with a fair degree of probability that it will always be found in relation to the inner or median half of the tumor, either lying among its lobules, or more often between the tumor and its capsule on its inner or median aspect.

It is evident from these anatomical considerations, and was most evident in the case to be reported, that the capsule furnishes a guide of the utmost importance to the surgeon. It would be recognizable by him even in the comparatively flimsy form in which it was present in these normal cadavers, but when it has been subjected for many months to the increasing tension of a growing tumor it becomes, or had become in this case, greatly thickened and was a structure so definite that though it might easily be missed by a careless surgeon, it would be identified with the greatest ease by one who was watching for it.

Upon consideration of the anatomical facts just enumerated, it will be apparent that while upon its upper or peritoneal surface the prerenal fascia is in contact with a most varied

collection of important and vital structures, most complicated in their relations and variable in their positions, the dangers which lie within it are few and are necessarily limited to certain comparatively circumscribed regions. Along the anterior surface of the tumor, but separated from it by the prerenal fascia and therefore entirely outside the perirenal cavity will be seen the descending or ascending colon in accordance as the attack may be made on the left or the right side of the abdomen; but as the vessels supplying the colon come from the median line, the surface of the tumor external to the colon will necessarily be free from any possibility of their presence. The capsule may, therefore, be incised with safety along the outer or lateral aspect of the tumor.

The technique of this incision should be as follows: In this situation,—*i.e.*, external to the colon, many small and comparatively unimportant subperitoneal vessels will be seen to cross the tumor transversely,—*i.e.*, in the direction which would be horizontal if the patient were upright. These will be found to move backward and forward over the surface of the tumor with the peritoneum, gliding backward and forward with it over the surface of the capsule, to which it is but loosely attached. The incision should be carried through the peritoneum only, in a direction parallel to and between these small vessels and without injuring them. They will give no further trouble. Space having been thus gained, and by retraction of the edges of the peritoneal incision a considerable portion of the white glistening capsule (the prerenal fascia) having been exposed to view, a similar incision directly beneath the other may be carried through the capsule with safety so long as it is thus limited to the outer or lateral aspect of the tumor. The yellow glistening perirenal fat will then come into view, but from published descriptions it is probable that the aspect of this fat will vary widely in different cases from the normal appearance of perirenal fat to a smooth, whitish, myxosarcomatous-looking substance.

The hand should next be inserted between the surface of

the fat and the inner surface of the capsule, where a distinct plane of cleavage will be found, and the capsule should be separated from the subjacent fat upwards and downwards for as long a distance as the hand can be made to pass along the outer and lateral aspect of the tumor, where no dangers are to be found. A similar separation of the fat from the capsule towards the median line should be conducted with more care on account of the probable presence of the ureter immediately beneath the capsule in this situation. In the smaller tumors it may be possible by this process of separation alone to carry the finger-tips into contact with the kidney, which will be found in its normal situation at the upper and posterior portion of the tumor, imbedded of course among the fat as a normal kidney is imbedded in the midst of the normal fatty capsule. When this can be done the ureter should at once be traced downward from the kidney and its passage followed throughout its entire length or until it is below the lower pole of the tumor, where it will be lost in the wall of the cavity as the prerenal and retrorenal fascia come together. In the larger masses, such as that which we have to report, the size of the hand and wrist and the great tension induced upon all the contents of the abdomen by the size of the tumor will render it impossible to reach the kidney without grave danger of tearing the colon or other important structures until after a preliminary reduction of the bulk of the tumor has been made, by some process of morcellement and delivery of the fragments through the incision. In this connection it is of the utmost importance to remember that from the position of the ureter and vessels the tumor may usually be morcellated with freedom and safety along its outer border until its bulk has been so far reduced that the further passage of the hand towards the kidney will be easily possible. In the softer tumors this morcellation may be safely and readily accomplished by separating lobules of the fat from the substance of the tumor with the tactile fingers; in the harder and firmer masses, such as ours, the use of an instrument may be necessary, but the dissection should always be

limited, if it is in any way possible, to the plane of separation between lobules and conducted with a remembrance of the possibility of encountering the ureter.

It is probable that the ureter, the only one of the surgical dangers which can by any possibility pass through the substance of the tumor in this region, will always be found attached to the prerenal fascia toward the median portion of the tumor and anterior to the anterior surface of the fat, but since we are not in a position to say positively that it may not have been dissected from the prerenal fascia by the increasing fat and may, therefore, pass to a greater or less extent through the substance of the tumor (though of course between its lobules) it is of advantage that this preliminary morcellation should be confined to the outer or lateral portions of the tumor from which the ureter is most certain to be absent, and that it should be limited as strictly as possible to the amount which is necessary to enable the hand to pass upward along the outer aspect of the tumor until it can reach the kidney and from there trace the ureter downward throughout its entire length by blunt dissection in the connective tissue between lobules. So soon as the ureter has been isolated the whole lower and outer portion of the tumor may be removed by similar morcellation, after separation from the capsule, without hesitation or fear, since all the other structures whose injury can by any possibility be incurred are strictly limited to the median line or to the upper portion of the tumor around the kidney.

When the lower and outer portion of the tumor has been removed the use of retractors to the edge of the incision in the capsule and the greatly decreased tension of the abdominal contents will make it easily possible to deal with the structures about the kidney and the median line by touch or sight. These structures are, in addition to the ureter, the kidney itself, the renal vessels, the aorta and vena cava, and the spermatic or ovarian vessels and both mesenterics during the upper portion of their course, where they necessarily cross the perirenal space and penetrate the new growth which has distended and occu-

pies it. In this region, however, the duodenum and pancreas lie in immediate contact with the perirenal space, though outside the capsule, being separated from it only by the prerenal fascia, and although the fingers of the surgeon within the capsule cannot directly injure these viscera, care and gentleness should be scrupulously observed to prevent traumatizing them.

The position and course of the renal vessels through the fat may be ascertained by following them from the kidney to the great spinal vessels with the fingers, gently separating them from the fat, which is always lobulated, and since the vessels necessarily lie between lobules, the connective tissue which separates the lobules will furnish a plane of cleavage for the free dissection of these vessels, by stroking motions with the fingers.

Since the new growth lies in direct contact with, and separated only by loose connective tissue from, the aorta and vena cava, the spermatic or ovarian vessels, and the superior and inferior mesenterics, great caution and delicate tactile sense must be here used in following the planes of cleavage between the various lobules of fat; but if the great mass of the tumor has been already removed so that tension is absent and the field of operation is readily accessible, this may be done largely by sight, and the intelligent pursuit of these known anatomical dangers should now offer not more than ordinary difficulties to any surgeon of fair operative ability. Its careful performance was in no sense difficult in our case. It must be remembered, however, that all these vessels penetrate the prerenal fascia and leave the cavity of the tumor at but a short distance beyond their origin, and that no attempt to follow them into the fascia and beyond their direct contact with the fat is for a moment to be allowed.

In the very largest tumors it may be necessary after removing one lateral half of the tumor through the incision just described, to abandon it for a moment and begin a fresh attack upon the opposite, outer, and lateral border by a similar incision, and by the same method, for the removal of the other

lateral half of the tumor; but as will be seen in the report of our case, which occupied three-fourths of the abdomen, it will probably be possible in all but the most extremely large tumors to free the renal vessels and ureter of the opposite side and complete the removal of the tumor piece by piece through the one incision.

The controlling factors in the technique throughout the whole operation are then, first, that so long as the fingers of the surgeon are within the perirenal fascia he has only the above-enumerated, definite, and known dangers to deal with; and, second, that these structures must all and always follow, throughout their course, the areolar tissue lying between contiguous lobules of the new growth; so that, in addition to the regional safety already emphasized (the safety of the outer or lateral aspect), the morcellation of the mass, lobule by lobule where this is possible, will greatly lessen the risk of injuring these few and easily-recognized dangerous structures.

To judge both from our own case and from the published accounts of other cases no hæmorrhage will be met with during the operation unless one of these *named* vessels is carelessly or accidentally injured. At some point near the upper end of the tumor one large vessel was found entering the tumor and distributing itself to the fat, but this was easily recognized as such, and was the only vessel tied.

REPORT OF CASE.—Miss N. A., 38 years old, teacher, was sent to us on November 25, 1904, by Dr. Franz Pfaff for the treatment of an abdominal enlargement, her only symptoms being those of neurasthenia and indigestion. A careful cross-examination brought out the following complaints, and these only:

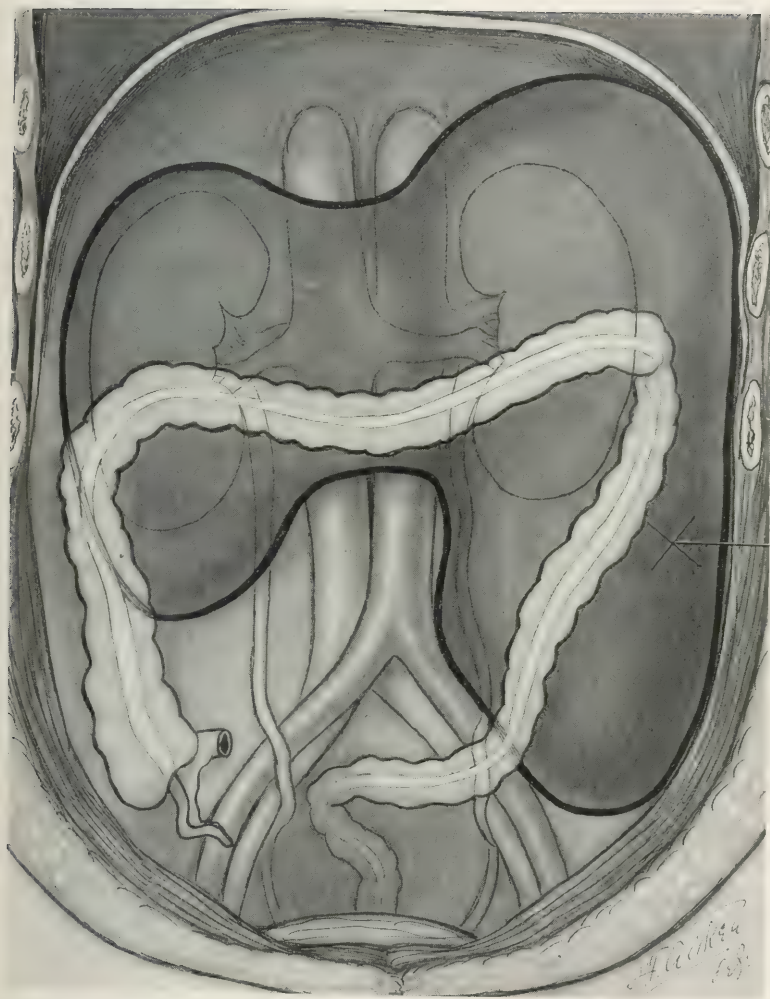
“Bloating” and regurgitation of acid fluid during digestion for nine months; “gas pains” in the epigastrium for one year; sensation of weight in the abdomen for eight months; had noticed an increasing girth for about the same period; catamenia regular and painless; standing and walking had caused some bearing-down sensation ever since puberty, but this had been decreasing lately; bowels moved daily with cascara, urination comfortable

but slightly frequent for some years. Had been neurasthenic from sixteen to twenty-six, and from thirty to thirty-three, both times with digestive symptoms, and was evidently in the same condition again. Family history good; relatives all long lived.

The patient was a very intelligent woman and an accurate witness. She had noticed nothing which differed from her previous attacks of neurasthenia with digestive symptoms, except an increase in the size of the abdomen, which was so uniform that she had not considered it important.

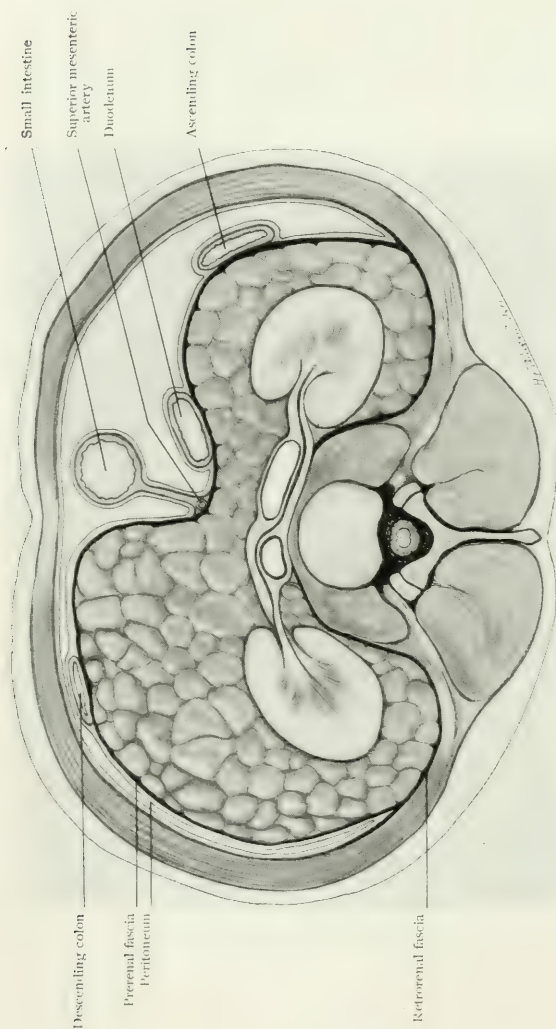
On examination the abdomen was uniformly enlarged and resistant, palpation giving no information. Percussion was dull in the right lower quadrant, and uniformly flat everywhere else, except in the epigastrium, where the tympanitic note was separated from the flat by an almost straight transverse line; change of position made no change in the results of percussion. On vaginal examination nothing was felt except that the uterus was rather far forward behind the pubes, no bulging of the vaginal roof. Under nitrous oxide nothing further was learned except that under strong abdominal pressure the lower surface of a rounded mass was brought within reach of the vaginal finger. It was smooth, elastic, and its under-surface was of about the curvature of the full term foetal head, lying mainly on the left of the median line. The diagnostic summary as written down at the time was: "Large new growth, probably ovarian (too high for an ovarian); malignancy cannot be excluded. Recommended immediate operation."

On opening the abdomen, slightly to the left of the median line and a little below the umbilicus, a large mass presented which was soon seen to be roughly cylindrical in outline, occupying the whole left half of the abdomen, and extending slightly beyond the median line to the right. It ended abruptly by a rounded extremity just above the brim of the pelvis, one of the longitudinal bands of the colon was visible on its surface and it was at first taken to be an enormously distended descending colon. A large soft rubber rectal-tube was passed into the anus by an assistant and guided upward through the sigmoid by the abdominal hand in the hope of passing an obstruction and emptying the tumor; its presence, however, readily demonstrated that the empty and flattened colon lay entirely in front of the tumor.



Region of comparative safety.

Semi-diagrammatic view of the anterior aspect of the tumor, showing the kidneys, ureters, renal vessels, aorta, and vena cava behind, and the colon in front of the tumor. The liver, not shown, was crowded upward and to the right: the small intestine, also not shown, lay wholly in the right lower quadrant.



Semi-diagrammatic cross-section through the tumor at the level of the renal vessels, seen from above. The preperitoneal and retrorenal fasciae unite to form the transversalis fascia. The whole intestinal tract lies in front of the preperitoneal fascia.

The incision was now enlarged upward and downward to a total length of about eight inches, and on stretching it apart laterally the peritoneum became visible on either side of the colon, the tumor being evidently retroperitoneal and behind the colon. Over the right or median aspect of the tumor the distended mesenteric vessels were plainly visible, while on the left, or outer, aspect was a very fine tracery of transverse parallel red lines, evidently enlarged and partly filled subperitoneal blood-vessels. This tracery (*i. e.*, the peritoneal and subperitoneal tissues) could be freely moved about over the surface of the tumor. The hand passed through the enlarged incision could now make out that the tumor extended upwards further than the hand could reach and that its upper portion evidently extended into the right side of the abdomen. The peritoneum to the left of the tumor (*i. e.*, external to the colon) being divided by a transverse incision running between the parallel subperitoneal vessels, a tough connective-tissue capsule came into view. The tumor was fluctuant, and the capsule was punctured in the expectation of getting fluid; fat appearing, however, the capsule was divided to the extent of the peritoneal wound, thus admitting the half hand between the capsule and the surface of the fat, which were easily peeled apart by the fingers. By very careful work the whole hand was eventually inserted without injuring the colon and the fat was now separated from the capsule in all directions as far as the hand could reach. The tension within the capsule was, however, so great as to make gentleness difficult and the hand was unable to even approximate the limits of the tumor without the use of an unjustifiable degree of force. The fat in the immediate vicinity of the incision was therefore drawn forcibly out of it and cut off with a knife, and this process of morcellement was alternated with further dissection of the tumor from the capsule by the fingers, until enough working space had been gained to permit of the removal of the whole lower part of the tumor, when the hand readily penetrated to the neighborhood of the left kidney. With the progress of the work it became evident that the tumor was lobulated throughout and the latter part of the morcellement was done wholly by separating lobule from lobule by gentle dissection with the fingers in the lines of cleavage between them. It is probable that this process could

have been adopted from the start and it would certainly have been far safer than the use of the knife.

With the approach to the perirenal region the fat of the tumor gradually assumed the characteristic appearance of the perirenal fat and was separated from the kidney, ureter, and renal vessels by careful dissection with the fingers, the kidney and its appendages finally lying plainly visible in the cavity so formed, and the spleen being evident just above it. The hand was then able to follow the tumor across the median line above the root of the mesentery and to separate it by careful work from the aorta, vena cava, and their branches. On the right side it became continuous with the right perirenal fat which was similarly separated from the kidney, renal vessels, and ureter, the tumor turning around the root of the mesentery and extending downward within a similar capsule to a distance some inches below the lower pole of the kidney. With each successive removal of a portion of the tumor the difficulty of the work decreased progressively and to a remarkable degree until the separation of the right side was attended by surprisingly little difficulty. At about the median line one large artery and vein were seen to enter the tumor and distribute themselves through the fat. They were easily recognized and tied. There was absolutely no hæmorrhage throughout the operation, and these were the only vessels tied. A fibroid about the size of a pea was removed from the fundus uteri. The pelvic organs were otherwise normal. A strip of gauze was placed in the tumor cavity and brought out through the upper end of the abdominal incision. The remainder of the incision was closed with through-and-through silkworm-gut stitches, with a continuous stitch of chromicized catgut to the peritoneum.

The entire mass removed was all that could be piled upon a large china (washstand) basin and weighed nearly fifteen pounds (14 lbs., 14 oz.).

There was a very profuse discharge of bloody serum through the first twenty-four hours and shock was marked, but was never regarded as really alarming. The wick was removed on the second day and thereafter the convalescence, though somewhat slow, was entirely uneventful, the patient sitting in a chair on the twenty-first day and leaving the hospital at the end of four weeks in very good condition. She returned to her work in about

four months, but being still somewhat troubled by neurasthenic indigestion was advised by Dr. Pfaff to take a year's rest. She is otherwise in excellent condition.

Although this operation was successful and although we believe it was conducted along the lines which should lead to a high percentage of success, the method adopted was reached purely by instinct from the necessities of the situation, and the dissection throughout was attended by the greatest anxiety to the operator, but the comprehension of the conditions which we have gained by the anatomical studies upon which this paper is based has made us feel that the attack upon a second case of this nature would be comparatively easy and safe.

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FALSE DIVERTICULA OF THE VERMIFORM APPENDIX.

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(From the Pathological Laboratory of the Medical Department of the St. Louis University.)

DIVERTICULA of the intestinal tract are classed as true or false, this classification being based on the histological structure of the wall of the diverticulum. If the wall is made up of all the normal coats of the intestine the term true diverticulum is used, as in the case of Meckel's diverticulum. If the muscular coat is lacking wholly or in part, it is called a false diverticulum. The true diverticula are practically always congenital, whereas the false ones are usually acquired. These facts all hold good for the appendix, in common with the rest of the intestinal tract, although there is no record in literature of an undisputed case of a true diverticulum of the vermiform appendix.

Considering the serious clinical import of these pathological structures, it is rather anomalous that they have received such scanty attention in our voluminous literature on diseases of the appendix. In American publications no reference to them has ever been made.¹ Kelly makes no mention of them in his encyclopedic work on the appendix; in the foreign journals only two articles have been written which deal exclusively with diverticula of the appendix, and only six or eight, all told, have been written, which treat of the subject, in connection with intestinal diverticula in general.

Practically all surgeons are agreed on the impossibility of establishing a correct anatomical diagnosis in the presence

¹ This statement will have to be modified, for since this paper was finished I found a reference (Cent. f. Chir. No. 7, 1906) to an article by Corning in the *Albany Medical Annals* for December, 1905, entitled Retention Cyst and Diverticulum of the Vermiform Appendix.

of appendicular disease. If it can be shown that serious involvement of this organ predisposes to diverticula formation, and that these pathological pouches are a menace to life, then another advance has been made in our attempts to link the pathological with the clinical aspect of appendicitis.

Through the kindness of Dr. Harvey Mudd I obtained an appendix which showed one large fully-formed diverticulum, and a small diverticulum in process of formation. The organ (Fig. 1) was removed by Dr. Mudd during the course of an abdominal hysterectomy for uterine fibroids. The patient gave no definite history pointing to an acute attack of appendicitis, having suffered only from pelvic pain and the other classical symptoms of fibroids. The appendix, which measured 7 cm. in length, was covered by a glistening non-congested serosa; 1 cm. from the distal end was a diverticulum measuring 8 mm. across the base by 4 mm. in height (Fig. 1 d); $2\frac{1}{2}$ cm. from the end was a small nodule (Fig. 1 d2)) which presented all the macroscopical appearances of the fibrous nodules so often encountered on the peritoneum, but which on microscopical examination proved to be the protrusion of the submucosa through a hiatus in the musculature. Both of these diverticula were situated midway between the mesenteriolum and the free convex border of the appendix. The lumen of the appendix was injected with 80-per cent. alcohol, the proximal end being tied off while the organ was distended, in order to preserve the contour of the diverticulum during the process of fixation. Serial sections were then made through the nodule d2 and the diverticulum d. Each series embraced healthy tissue above and below these structures.

Fig. 2 shows a cross section through the large, fully-developed diverticulum represented as in Fig. 1. The muscular coat is broken in two places,—at b, where a normal break always occurs to admit the mesenteric blood-vessels, and at x-x, where the mucosa and submucosa protrude to form the diverticulum. The break in the muscularis caused by the entrance of the mesenteric blood-vessels is filled in by the vessels themselves, and by perivascular connective tissue. Yet, despite this fact, the broken continuity creates a locus minoris resistentiæ at this point, which, as a result, constitutes a site of predilection for diverticulum

formation. In the present case, however, the diverticulum did not form at this point of natural weakness, but at a spot almost directly opposite to the mesenteric attachment. The ends of the muscular coat thin down and terminate abruptly at x-x, as if they had been trimmed with a knife. Sections taken at a different level, however, show a somewhat different picture, in so far as the two ends of the muscle-crescent do not terminate abruptly, but are prolonged as thin fibres, into the wall of the diverticulum, along a part of its circumference. The muscular coat in Fig. 3, which represents a section through d2 Fig. 1, shows a loss of substance similar to that seen in Fig. 2. Aside from this loss of substance, there is no other pathological change in the muscle; no fragmentation, fatty infiltration or degeneration, and no nuclear changes. The structure of the submucosa varies in no way from the normal structure of this coat, except that it protrudes between the ends of the muscle-crescent to form part of the wall of the diverticulum in Fig. 2, and to form the subperitoneal nodule in Fig. 3. The mucous membrane in both sections is also normal as regards the distribution of the lymphoid tissue, the size, shape and number of crypts, and the character of the epithelium lining these crypts. The lumen of the appendix (1, Figs. 2 and 3) is not situated centrally as it should be, but has been forced into an excentric position by the protrusion of the coats. This excentricity of the lumen is a characteristic result of diverticulum formation. Fig. 4 is a schematic representation of the development of this displacement of the lumen. The uppermost drawing of Fig. 4 shows a section taken just above the small nodule d2 (Fig. 1). The lumen is centrally situated. As the sections proceed downward toward the tip of the appendix, they pass through the nodule, showing both the bulging of submucosa through the muscularis, and the displacement of the lumen. This excentricity is, of course, due only to the thinning out of the appendicular wall in one place and the thickening of it in another.

The wall of the diverticulum itself is made up throughout two-thirds of its extent by mucosa, submucosa and serosa (Fig. 2). There is an entire absence of muscularis, except where the horns of the muscle-crescent embrace the proximal part of the diverticulum. The submucosa does not differ in appearance from

normal submucosa; but the mucous membrane lining the diverticulum varies markedly from normal appendicular mucous membrane, in that the lymphoid tissue is more sparsely distributed, the crypts less numerous, and more irregular in shape, and the epithelium lining them of low cuboidal instead of high cylindrical shape. Similar changes in the mucosa lining the diverticulum have been described by V. Brunn² and by Lejars and Ménétrier,⁴ authors who refer these changes to the existence of a past inflammation, which, in their opinion, accounts for the formation of most diverticula of the appendix. There is an absence of muscularis mucosæ both in the wall of the appendix and in the wall of the diverticulum. Obendorfer¹¹ states that absence of the muscularis mucosæ points to the fact that the appendix was the site of a chronic inflammation.

The Site of Diverticula of the Appendix.—By far the largest proportion of the fifteen or twenty diverticula of the appendix recorded in literature, occurred at the mesenteric attachment of the organ. This fact is readily understood, after a glance at Figs. 2, 3, and 4, which show how the continuity of the muscularis is interrupted, in order to afford entrance to the nutrient blood-vessels. As already stated, this break in muscular continuity causes a locus minoris resistantiæ, and allows the submucosa and mucosa to be herniated through the weak spot, to form a diverticulum lying between the leaves of the mesentery. The muscular coat is preëminently the strong coat of the appendix. Oschner¹ has stated that no other tube in the body possesses so thick a muscularis, in proportion to its size, as does the appendix. The submucosa is strong by reason of its passive opposition to the intra-appendicular pressure, but the muscularis, in addition to the passive opposition afforded by its thickness, exerts active opposition through its contractile power. Naturally, therefore, that spot where the muscularis is lacking, will be a weak spot, and one through which a hernial protrusion is most likely to occur.

But the mesenteric border is not the only site at which the muscularis may be lacking. Defects may occur in any

part of the muscularis, and as a result, diverticula are reported by von Brunn,² Edel³ and Lejars and Ménétrier⁴ as occurring in the neighborhood of or opposite to the mesenteric border of the appendix. The appendix dealt with in this paper showed an intact mesenteric border, with hernial protrusions near the opposite side. As regards situation, therefore, diverticula occur most frequently at the mesenteric border, but they may occur also at any point on the circumference of the appendix.

The Etiology of Diverticula of the Appendix.—Two factors are essential for the development of these diverticula, a weak spot in the wall of the appendix, and pressure within the appendicular lumen sufficient to cause the mucosa to be forced outward through the weakened wall. Both of these factors are present in every normal appendix; for there is always a positive intra-appendicular pressure greater than the negative intra-abdominal pressure: and the muscularis of the appendix is always broken by the entrance into and passage through it of the nutrient vessels, coming from the mesenterium. The fact that the muscularis is weakened by the blood-vessels coursing through it has been demonstrated experimentally by several authorities. Heschl⁵ removed pieces of intestine from the body, and distended them with water. He found that after the intestine was distended, small points of bulging could be seen along the mesenteric border. These artificially-created diverticula disappeared as the water was let out. Hansemann⁶ confirmed Heschl's observations, and Grassberger⁷ independently reached the same conclusions.

It is only natural to suppose, then, that since the mesenteric border of the appendix is naturally a locus minoris resistentiæ, and that since there is always a positive pressure present in the appendix, we should expect diverticula to occur most frequently along the line of mesenteric attachment. This supposition is confirmed by the list of cases already recorded in literature. Yet there is an important group of cases in which the diverticula do not form along the mesenteric attachment,

but along the convex border of the appendix. Here, as in the former cases, the two factors of intra-appendicular pressure, plus a weak spot in the appendix wall, are present; but the weak spot in the wall is an acquired one, the result of past inflammation. The patient may have been the subject of a very acute appendicitis which resulted in perforation, or he may have suffered from a less severe attack, without perforation. In either case, however, the appendix wall was destroyed at one point (by a process of necrosis in the one case, or by a dense round-cell infiltration in the other). The mucosa of the appendix, in common with the mucosa of all other organs, possesses the power of regeneration. The submucosa and the endothelial cells of the serosa also manifest this same property. The muscularis, however, being one of the most highly-evolved tissues of the body, cannot regenerate. The result of all this is, that after a severe acute attack of appendicitis the involved portion of the wall of the appendix shows a regenerated mucosa and submucosa, and a muscularis in which the parenchyma has been replaced by connective tissue. While this connective tissue is young it is yielding and plastic, and being thus weaker than the normal muscularis, it gives way before the intra-appendicular pressure behind it and thus permits a diverticulum to form.

Although the two factors—a weak wall and pressure from within—are constantly present, we see nevertheless that there is the third important factor, inflammation, to take into account when considering the etiology of diverticulum formation. A previous inflammation of the appendix not only furnishes a *locus minoris resistentiæ*, but determines where the diverticulum will form. If the convex border of the appendix was the site chiefly involved, a diverticulum may form here; if the mesenteric border was chiefly involved, a diverticulum may form at this site, which, though naturally a weak spot, was nevertheless strong enough to resist diverticulum formation until compromised by the acute inflammatory attack.

THE CLINICAL SIGNIFICANCE OF DIVERTICULA OF THE
APPENDIX.

Diverticula of the appendix are of the most serious clinical import; and it is only due to the fact that they have up to now been regarded as pathological curiosities, that their true clinical significance has been overlooked. Undoubtedly the most dreaded outcome of appendicitis is perforation, with consequent purulent peritonitis. The diverticulum furnishes the most favorable set of conditions for perforation. A thin-walled sac with no muscularis in its make up, opening into the appendicular lumen, through a mouth that is always small, and therefore easily closed off by swelling of the mucosa or by a plug of feces, must be a highly dangerous intra-abdominal content. Of course, after an appendix has perforated it is rather fruitless to attempt to show whether the perforation occurred at the site of a former diverticulum or not. Von Brunn⁹ and Mertens¹⁰ both assert the belief that cases of perforation under their observation were referable to diverticulum formation. Even granting that a diverticulum does not perforate, it is still a menace, for Helmberger and Martina⁸ have shown that it is chiefly the muscular coat of the intestine which opposes the migration of bacteria from within; and in diverticula, the muscular coat is absent.

There is no small amount of significance in the clinical fact that in the large majority of foudroyant cases of appendicitis there is a previous history of repeated acute and subacute attacks, terminating finally in a particularly stormy attack with peritonitis. In our own case, there was no definite history of appendicitis; yet it is very probable that an attack of pain, in this particular individual, would have been referred to the presence of the large fibroid uterus. The increment in severity which marks the successive attacks of appendicitis may be fairly assumed to depend upon the damaged condition of the appendix. Since it has already been shown how this damage may result in diverticulum formation, the clinical

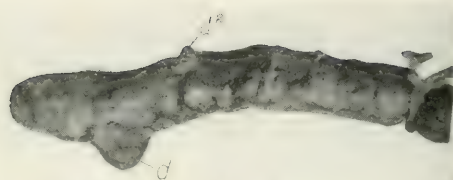


Fig. 1

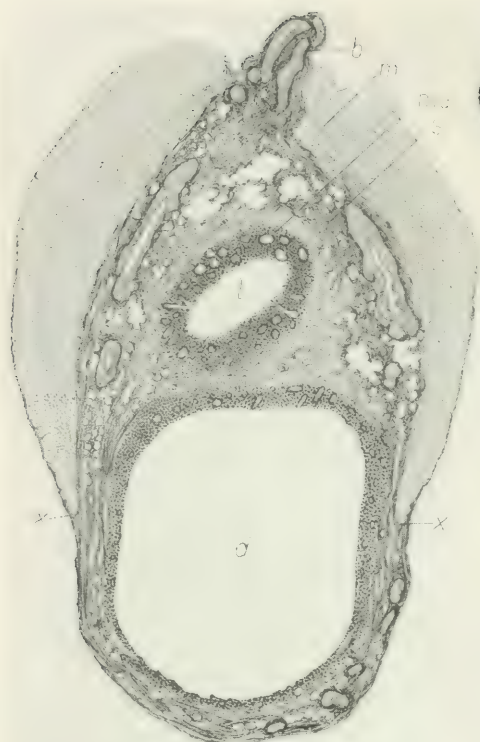


Fig 2



Fig 3

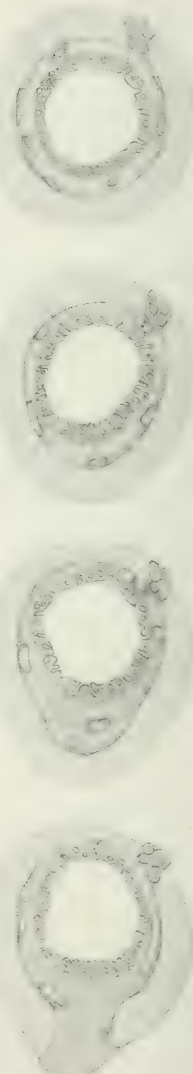


Fig. 4

significance of these structures becomes apparent without further comment.

It must be borne in mind, of course, that a somewhat differing significance attaches itself to diverticula according to whether they have formed idiopathically, through the weak cleft caused by the vessels entering the muscularis, or whether they have resulted from past acute inflammation. Concerning diverticula which protrude between the leaves of the mesentery, we can only say that they are a constant menace, but that their presence is unsuspected until, owing to the thinness of their wall, infection travels through them or perforation occurs. The diverticula that result from inflammation, however, are of more significance to us, in that a knowledge of the possibility of their existence enables us to set a very definite indication for operation in those cases of appendicitis after an acute attack. At all events they teach us that there are excellent pathological reasons for anticipating serious trouble from the appendix which has once been markedly compromised by inflammatory disease.

EXPLANATION OF PLATE.

Figure 1.—Photograph of appendix enlarged one-third. d, fully formed diverticulum; d², small nodule formed by protrusion of submucosa.

Figure 2.—Section through d (Fig. 1). b, blood-vessels from mesenterium; m, muscularis; mu, mucosa; s, submucosa; x-x interruption in continuity of muscularis; l, lumen of appendix; d, lumen of diverticulum.

Figure 3.—Same as Fig. 2.

Figure 4.—Gradual displacement of lumen of the appendix to an excentric position as a result of protrusion of the submucosa.

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CLINICAL EXPERIENCES WITH MECKEL'S DIVERTICULUM AND OTHER VESTIGES OF THE OMPHALOMESENTERIC DUCT.*

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MY observation of the congenital anomalies mentioned in the title of this paper is limited to the following instances:

CASE I. *A Meckel's diverticulum on the mesenteric side of the ileum.*—I reported in 1896¹ a case of diverticulum, arising from the ileum a few inches above its entrance into the cæcum, seen while assisting Dr. L. W. Steinbach in an abdominal operation. This diverticulum was an inch and a-half long, with a base about half an inch wide, and tapered to a rounded end like the finger of a glove. It was connected with the gut at its mesenteric border and was attached to the mesentery or developed upon it. It was not the seat of any inflammatory action and its point was directed upward,—that is, away from the cæcal end of the ileum. It had nothing to do with the condition for which operation was done, which was obstruction due to old inflammatory adhesions about the colon near the cæcum.

CASE II. *Fatal strangulation of the intestine by cord consisting of obliterated omphalomesenteric vessels.*—About ten years ago I saw a middle-aged man, with Dr. H. A. Stout, of Wenonah, N. J., dying with great distention of the abdomen from intestinal obstruction of five days duration. We prepared for immediate operation, but the man died just after he was placed upon the operating-table.

The autopsy showed a loop of bowel encircled by a thin cord of fibrous tissue, looking like the white string used for tying up parcels. This cord was about thirteen centimetres long, and

* Read before the Philadelphia Academy of Surgery, March 5, 1906.

¹ ANNALS OF SURGERY, XXIII, 1896, p. 612.

extended from the front wall of the abdominal cavity to the mesentery above the point of strangulation of the bowel. From another part of the bowel hung a pedunculated mass, four and a-half centimetres long. The cord ran through an opening in this appendage, as through a pulley. The appendage arose from the intestine opposite the mesentery, but had no lumen. The specimen was exhibited to the Philadelphia Pathological Society on October 28, 1897. Dr. David Riesman² considered the cord to be the obliterated vitelline, or omphalomesenteric, vessels.

CASE III. *Strangulation of the ileum by a Meckel's diverticulum (a remnant of the omphalomesenteric duct), relieved by operation.*—A boy, four and a-half years old, was brought to me by Dr. H. J. Butte on January 8, 1906, with a history of unrelievable intestinal obstruction. He had complained of pain in the abdomen for four days previously, which he attributed to a kick by another small boy. Vomiting had occurred promptly and was accompanied by absolute constipation. There had been no previous abdominal crises in the history of the case. At the time of admission the temperature, pulse and respiration of the boy were practically normal.

After two or three hours' observation, an incision was made near the middle line of the abdomen, extending from an inch above the umbilicus to a point two inches above the pubes. The intestines were markedly distended and congested. About three feet from the ileocæcal valve a slender diverticulum of the ileum was found. Its diameter was less than that of the normal vermiform appendix. Its end was a mere fibrous cord attached to the abdominal wall near the umbilicus. The structure was distended at its middle into a sac similar to that which is sometimes seen in the appendix when it is inflamed. Between this sac and the ileum there was a patent tube lined with mucous membrane. There was evidence of inflammation of these structures. The ileum a short distance from the point of origin of the diverticulum was tightly strangulated by the passage of the diverticulum and its fibrous continuation across it. A deep groove was thus made in the portion of the bowel opposite the mesentery, similar to

² Meckel's Diverticulum and the Omphalomesenteric Duct, University Medical Magazine, June, 1898.

that often seen in cases of tightly-strangulated hernia at the femoral or inguinal ring.

The cord-like end of the diverticulum was detached from the belly wall, and the diverticle itself was ligated near its ileac attachment and removed. The groove made in the gut, thus relieved from pressure of the tense band, was so dark that I feared that perforation from sloughing would occur. I therefore turned in the suspicious portion by a series of Lembert's sutures. The mesenteric glands were very large, and the veins in the mesentery greatly distended and black, as though actual thrombosis had occurred. There were a few flakes of lymph on the surface of the bowels, but no distinct peritoneal inflammation existed. An attempt was made to bury the stump of the diverticulum after its mucous membrane had been sterilized with a drop of undiluted carbolic acid. If my recollection is correct, I finally abandoned the endeavor to bury it, because of the tension made on the wall of the gut by the sutures, which had to be placed so near those used to turn in the constricted area. When I made the abdominal incision, which was near the middle line, I had to avoid on the inside of the belly-wall a white fibrous cord, which was probably the remains of the right hypogastric artery or the urachus.

For a good many days the patient's conditions was rather critical, with high temperature and a weak, intermittent pulse. A movement of the bowels was obtained on the day after operation. Some days afterward the stools became exceedingly offensive and suggested the possibility of there having occurred some sloughing at the point of former strangulation. The convalescence, however, continued satisfactorily, and at the end of a little over three weeks he was discharged from further surgical observation.

CASE IV. *A Meckel's diverticulum found at autopsy.*—Within the last week, I have obtained a specimen, from a patient, whom I treated at the Polyclinic Hospital for traumatic rupture of the bladder and fracture of the pelvis. He died a month after injury from hæmorrhage occurring from duodenal ulcer.

At the autopsy, made by Dr. John M. Swan, a diverticulum was discovered, about four inches long. At its origin it is about the size of the ileum. It resembles in shape the finger of a glove.

It was situated about two feet from the ileocæcal valve. The man's death was in no way dependent upon the existence of the anomaly.

CASE V. *A possible instance of persistent, though modified, omphalomesenteric structures.*—In 1895 I exhibited to the Section on General Surgery of the College of Physicians of Philadelphia³ a pedunculated myxoma of the abdominal cavity. While operating on a very large umbilical hernia in a woman, I found among the intestines in the sac a translucent tumor as large as a pea. It had a long thread-like translucent pedicle descending into the abdomen. The growth was not attached to the hernial sac or its contents. The slender stalk was pulled out of the opening in the belly-wall till a foot or more was in my hands. Its lower attachment was not revealed. The tumor and a part of its foot-stalk were excised.

Dr. W. M. L. Coplin examined the specimen and pronounced it a myxoma. It was covered by epithelium, most of the cells of which were flattened, though some were more rounded in contour. The pedicle contained a single artery and vein, but no nerve-fibre was evident.

I have thought that perhaps these structures might have been the remains of the omphalomesenteric vessels, which had become free at the umbilical end and by modification had been transformed into the pedunculated tumor.

The surgical lesions liable to result from congenital persistence of the omphalomesenteric duct, in whole or in part, should be borne in mind by operating surgeons. This tubular structure, leading from the primitive intestine to the vitelline, or yolk sac, is usually obliterated in the second month of embryonic life. It may, however, remain patulous in the fœtus and cause a congenital intestinal fistule at the navel in the child after birth. This condition is similar in origin to the urinary fistule at the navel, due to an unobliterated urachus.

In other cases the umbilical portion alone may fail to undergo embryonic obliteration and leave a pouch at, and inside of, the navel lined with mucous membrane. Occasionally, and

³ ANNALS OF SURGERY, XXIII, 1896, p. 295.

perhaps more frequently the intestinal end remains open and gives rise to a Meckel's diverticulum of the intestine.

In still other cases the two ends of the duct may undergo the normal disappearance, and leave an unobliterated tube, or cyst, in the middle region; or the entire duct may disappear, leaving, however, a simple fibrous cord, representing the omphalomesenteric blood-vessels.

Various degrees of involution modify these conditions, and quite an array of surgical lesions needing operative treatment result therefrom.

Many cases of strangulation of the bowel, supposed to be due to old inflammatory adhesions are doubtless due to vestiges of the omphalomesenteric duct resembling inflammatory bands. Fistule at the navel, supposed to be caused by a sloughing umbilical hernia, is sometimes a persistent duct. The diagnosis is not very difficult, if the possibility of the rarer condition be remembered.

A diverticulum may become the seat of ulceration and perforation, like the vermiform appendix, from pyogenic or typhoid infection. It may be the cause of intussusception, and may be the whole, or a part, of the content of a hernial sac.

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A METHOD OF ANASTOMOSIS OF THE VASA DEFERENTIA.

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ANASTOMOSIS of the vasa deferentia is demanded under three conditions, viz:

1. Accidental severing of the duct, either from traumatism or during the performance of surgical operations.
2. After resection for the relief of stricture of the vas or the removal of new growths.
3. Where the vas has been resected on one or both sides for therapeutic purposes and, the object of the resection having been accomplished, restoration of the continuity of the duct is desired.

If a practical, easy, safe and fairly certain method of anastomosis is available, temporary occlusion of the vasa deferentia by resection or ligation is a logical indication in some of the most important conditions with which the surgeon has to deal. I believe that I offer herewith an operation which fulfills these indications. I have performed it in four cases, once with success, once with apparent failure, and twice in cases in which I have had no opportunity to determine whether the operation was successful or not. With my present perfected technique I believe that a large majority of cases operated should be successful. With even a fairly successful method of anastomosis at hand, one may, in my opinion, legitimately employ resection of the vasa deferentia for the relief of the following conditions:

1. Stricture of the vas.
2. Benign neoplasms involving the vas.
3. Incipient prostatic enlargement.

4. Obstinate cases of irritability of the vesical neck.
5. Intractable chronic prostatitis.
6. Intractable seminal vesiculitis.
7. Doubtful tumors of the testis in which we desire to protect the urinary way from possible infection.
8. Suspected tuberculosis of the testis in which operation on the testicle itself is refused.
9. Cases of true spermatorrhea.
10. Cases of spermatophobia in which the mental condition is practically a psychopathy.
11. Certain rare cases in which involuntary seminal emissions are frequent and intractable. (I have met with cases of married men who were afflicted in this way.)
12. Obstinate cases of prostatorrhea.
13. Masturbatory insanity.

Laying aside all theoretic speculation as to the effects of resection of the vasa deferentia, this much is certain, viz., that the operation affords rest to the seminal vesicles and prostate, and lessens their blood supply. The effects of this upon congestive and inflammatory conditions is obvious. In psychopathic subjects, the cessation of visible discharge secured by the operation has a profoundly beneficial effect. One of the favorable points of the double anastomosis of the vasa deferentia is that the continuity of only one duct is sufficient for fertility, and this doubles the chances of success from the operation. The length of time that should be allowed to elapse after resection before anastomosis is performed, of necessity varies with the case.

Technique.—The cord is exposed by an incision about two inches in length. The sheath of the cord is incised carefully and the edges caught with snap forceps. The vas is now carefully separated from the cord and its fascial envelopments, and the requisite portion excised. Where a previous resection has been performed according to my method, a small nodule is found and excised at the site of the previous resection. In my resections where I anticipate performing anastomosis at

some future time, I join the severed vas, as shown in figure 1. This prevents reëstablishment of continuity,—granting this to be possible,—and enables the surgeon to readily find the severed ends when he desires to make a true anastomosis.

Both ends of the vas are now probed with a fine filiform bougie, or a bit of silkworm gut,—the latter suggested by my friend, Dr. Ries,—to determine whether the lumen of the vas is patent for a reasonable distance. The duct is now bent at about a right angle and a sharp-pointed probe or long rounded needle passed through the wall of the vas about $1\frac{1}{4}$ in. from the cut end. (Fig. 2.) A straight strand of the largest size silkworm gut is now passed into the proximal end of the vas and made to emerge at the opening made by the probe or needle. This is drawn through until about three inches of the silkworm gut protrudes. The other end of the strand of gut is now threaded into the distal portion of the vas and the two ends of the severed vas brought together over the coupling thereby formed.

A fine catgut stitch is now inserted in the vas at the line of the anastomosis and tied securely. A second stitch is placed directly opposite the first. In my opinion these stitches are made unnecessary by the next step of the operation, although they make assurance doubly sure in maintaining apposition of the ends of the vas. The edge of the sheath of the cord is now stitched upon itself so as to enwrap the vas in a distinct sheath. The opposite edge of the fascia is now stitched over the cord to the sheath just made for the vas. (Figs. 4 and 5.)

A continuous suture of fine catgut is used, but for clearness of illustration interrupted sutures are shown.

The vas for about an inch or more beyond the line of union of the duct is thus enveloped in a snugly-fitting sheath of fascia that absolutely seals the ends of the tube and prevents them from slipping apart.

The free strand of silkworm gut is passed through a small puncture in the skin just above the upper angle of the wound.

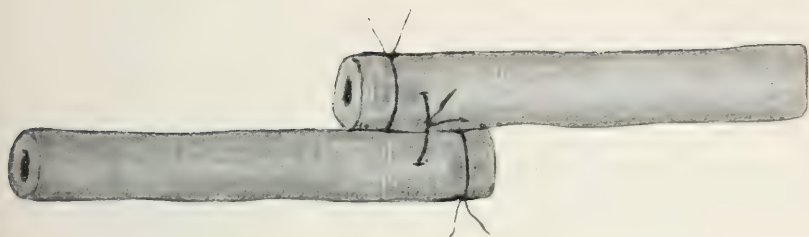


FIG. 1.

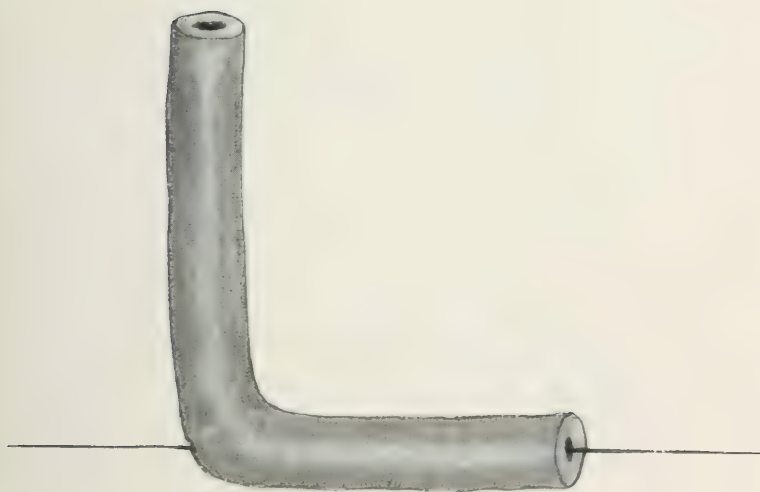


FIG. 2.



FIG. 3.

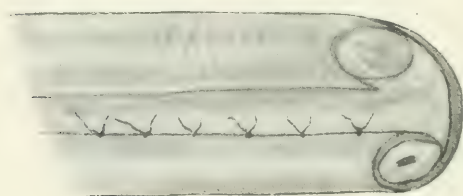


FIG. 4.

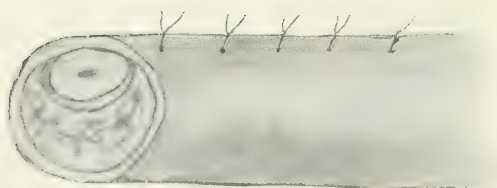


FIG. 5.

(Fig.6.) It is not wise to use a needle for this purpose, lest the portion of the gut that occupies the lumen of the vas be disturbed.

The skin wound is now sutured in the usual manner, with fine catgut or horse-hair

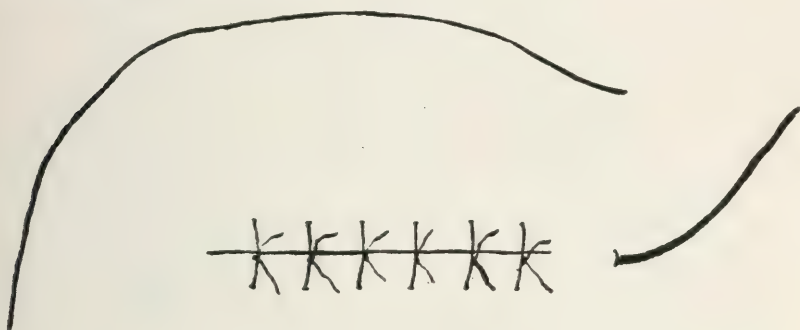


FIG. 6.—Anastomosis of Vasa.

and the ordinary dressings applied. On the tenth day the strand of silkworm gut is withdrawn. A very fine whalebone filiform bougie may be used instead of silkworm gut for coupling the vas.

The advantages claimed for the foregoing are briefly:
1, Accurate anastomosis, not to be secured in any other way;
2, immobility of the anastomosed vas, so necessary to union;
3, maintainance of perviousness of the vas, which is not insured by any other method; 4, simplicity, ease, and rapidity of performance.

EXTRAPERITONEAL LIGATURE OF EXTERNAL ILIAC ARTERY FOR ANEURISM.

REPORT OF A RECENT CASE FOLLOWED BY RECOVERY.

BY JAMES A. NYDEGGER, M.D.,

Surgeon in the United States Marine Hospital Service.

THE following case is reported to add to the records of such operations, which are of rather limited number and which according to the published statistics from one cause or another have resulted in a rather high mortality. Bryant in his *Operative Surgery*, (1904), states the external iliac artery has been ligated one hundred and seventy-three times, with sixty-one deaths from various causes.

J. G. Finland, age 52, was admitted to the Marine Hospital, New York, under my care on November 5, 1905, with a large saccular aneurism of the upper third of the left femoral artery.

The patient was a large man, well nourished, and possessed with a large amount of adipose tissue. He stated that his habits were fair, but he smoked and drank a good deal at times. He had had three attacks of gonorrhœa, the last one being over ten years ago. He had rheumatism fourteen years ago, all the extremities being involved. He stated that he had suffered from syphilis some eight years previously. A scar was present in the left groin and a number of glands in the same groin were enlarged.

About two months ago he first noticed a small swelling in the left groin which was painful and rapidly increased in size until his admission into the hospital.

On admission there was a large swelling in the left groin, about four inches long and about three inches and a-half in transverse diameter, extending well up beneath Poupart's ligament. The pulsation was strongly expansile, and a loud systolic bruit was heard on auscultation. There was marked pain, which was described as burning in character. Considerable swelling of the left thigh, leg and foot was present, though this condition

partially subsided at night while in the recumbent position. There was no history of injury.

The patient was put to bed to rest for a few days, but as the aneurism visibly increased in size and the pain continued, an operation was decided on at once.

After the usual preparation of the patient, the operation was performed on the 8th of November, the anæsthetics employed being chloroform and ether. After having been placed in the Trendelenburg position, a straight incision, beginning immediately to the outer side of the external abdominal ring, about an inch above Poupart's ligament, and terminating on a level with, but about two inches internal to, the anterior superior spinous process of the ilium, was made. When the peritoneum was reached it was pushed upward and backward and the whole held back by blunt retractors. Considerable difficulty was experienced in exposing the vessels. A number of enlarged glands interfered and were worked aside from the vessels with the fingers. The areolar tissue forming the sheath over the vessels was scratched through by the same means. The ligature, heavy kangaroo tendon, was carried around the middle third of the vessel and secured by a combined reef knot and surgeon's knot. The pulsation in the aneurism ceased at once. The wound was thoroughly closed by carrying chromicised catgut ligatures deeply, near to the peritoneum. The integument and fascia were united separately. The leg was swathed in cotton and lightly bandaged, and a long lateral splint applied. Hot-water bottles were kept to the leg for two days. On the sixth day the stitches were removed. The wound had completely healed. At first there was a noticeable difference in the color of the leg. This gradually disappeared as the circulation became reëstablished. The discoloration disappeared before he was discharged from the hospital, four weeks afterward. The aneurismal swelling decreased in size, and appeared firm and completely organized between the third and fourth week.

The day following the operation the patient developed a severe ether pneumonia, which lasted for ten days. There were no other complications.

Considerable difficulty was experienced in passing the ligature owing to the wound being made doubly deep by the thickness of the adipose tissue over the abdomen.

WYETH'S METHOD OF HÆMOSTASIS IN AMPUTATION AT THE HIP AND SHOULDER.

REPORT OF PRIMARY AMPUTATIONS, ONE AT THE HIP JOINT,
THE OTHER A DOUBLE THIGH AND SHOULDER JOINT
AMPUTATION.

BY THOMAS H. HANCOCK, M.D.,

OF ATLANTA, GEORGIA.

Amputation at the Hip.—About midnight of November 25, 1905, A. L., male, white, age 18, fell from the platform of a passenger coach, the wheels of several trucks passing over his left lower extremity, reducing to a pulp the entire limb with the exception of the foot and knee. The femur was crushed within three inches of the great trochanter.

About thirty minutes after the accident he was admitted to the hospital and I arrived a few minutes later. The pulse respiration and general condition were fairly good, and the injury being of such a character that it was difficult to control hæmorrhage, I decided to amputate at the hip joint at once.

Chloroform followed by ether. I inserted the steel pins and applied the rubber tubing after the method of Wyeth. On account of the destruction of the skin a long, internal posterior and a short anterior flap was used. As the operation was proceeding a pint of normal salt solution with half an ounce of whiskey was injected into the subcutaneous tissues in the pectoral region. A quarter of a grain of sulphate of morphia and one-hundredth of a grain of sulphate of atropia had preceded the anæsthetic. The amputation was made with an ordinary scalpel and the vessels ligated as they were cut before retraction could take place. The head of the bone was removed with considerable difficulty on account of its being crushed off so short that no leverage could be obtained. By tying a piece of sterile gauze around the neck and using this to make traction the ligamentous attachments were cut with curved scissors and the scalpel and the bone was removed. A rubber drainage-tube was inserted extending up into the acetabulum and

projecting from the lowest portion of the wound, which was closed with silkworm-gut sutures.

Although practically no blood was lost, the patient toward the close of the operation began to show considerable signs of shock and was given a hot saline enema, one pint with one ounce of whiskey, before being removed from the operating-table. In addition $\frac{1}{30}$ of a grain of sulphate of strychnia and ten minims of the 1-1000 solution of chloride of adrenalin were hypodermatically administered. This enema, the whiskey being reduced to one-half an ounce and the hypodermatic injection, were repeated every three hours during the following twelve hours, and at 5 P. M. of November 26 an additional quarter of a grain of morphia was administered beneath the skin. This night he was also given three grains of calomel and soda at 8 o'clock and allowed nothing but liquids. All of the enemata were retained.

For the first twenty-four hours his temperature ran from 100 to $98\frac{3}{5}$, pulse from 120 to 164, respiration 30 to 20. On the following day, at 4 o'clock, A. M., he was given one half ounce of salts, which was promptly vomited. It seemed almost impossible to secure a movement from the bowels and injection of a quart of soapsuds was made into the lower bowel and retained. Two hours later one ounce of alum to a pint of water was thrown in and followed by a glycerine suppository. These were all retained and at 6 P. M. he was given an enema consisting of Fel. Bovis Pulv. \mathfrak{z} ss Glycerine \mathfrak{z} vij to two pints of water. The bowels moved promptly after this enema, the stool being copious and dark, chiefly liquid. The patient's condition immediately improved and his recovery was uneventful. The drainage-tube was removed on the third day; sutures on the tenth.

Double Amputation at Hip and Shoulder.—On September 14, I was called to see B. E. S., white, age 26, who had been run over by an engine, his left thigh being crushed in the middle third and his right arm crushed off at the shoulder joint. Shock had not supervened when I saw him, an hour after the accident, and I operated immediately under ether anæsthesia.

My first intention was to cut away the mangled tissues and endeavor to control the hæmorrhage, and later to complete the operation, but his condition seemed favorable and I proceeded to do the thigh amputation first and then the shoulder-joint.

Wyeth's pins and rubber tubing controlled the hæmorrhage as absolutely at the shoulder as at the hip in the first case. There was practically no loss of blood during the amputations. He was given a hot saline enema, one pint with one ounce of whiskey, before he was removed from the operating-table. He also had $\frac{1}{60}$ of a grain of sulphate of strychnia at intervals of three hours for the first twenty-four hours following the operation. The drainage-tubes were removed on the third day and the sutures on the tenth. The wounds healed by first intention and he was discharged at the end of twenty-four days.

The two cases are interesting from the fact that it is not customary to have such slight shock with such severe injuries. The shock would undoubtedly have been profound had the operation been postponed for any considerable length of time. I believe that by operating quickly, before shock occurs, a more favorable outlook may be expected. In any event, the mangled tissues should be cut away, hæmorrhage controlled by ligature or the rubber bandage, which should always be applied at the end of the stump and thus avoid the extreme pain which follows its application well above the injured area.

It is important, as advised by Estes, that the constriction of the rubber bandage should extend slightly above the crushed tissues in order to compress the veins and lymphatics and thus prevent the ingress of septic organisms or their products from the infected area.

The general practice of administering whiskey by the mouth gains nothing and makes vomiting more certain. It should be used by the rectum or hypodermatically. The infusion of warm normal salt solution, with strychnia and with the chloride of adrenalin and the direct application of heat, are our best means of preventing shock or inducing reaction.

I have observed that some of the severest cases of shock are preceded by little or no hæmorrhage. The transferring of these cases over rough roads or in unsuitable conveyances is very trying and often adds to the danger of inducing shock. Patients should be moved as little as possible. Hæmorrhage

should be controlled at once, heat applied, stimulation employed, and operation as soon as the patient's condition will allow.

The method of controlling hæmorrhage in amputation at the hip and shoulder-joint introduced to the profession by Professor John A. Wyeth in 1890 meets every requirement in these formidable amputations. The application is simple and it is so satisfactory that in my opinion there is no room for improvement. The gradual dissection method, without the application of the tourniquet, tying the vessels as you go, as advised by Estes, is tedious and is accompanied by a loss of blood which does not follow the Wyeth method, and in addition an unnecessary amount of time is consumed.

Instead of completing the disarticulation, as advised by Wyeth, before tying any of the blood-vessels, I have found it advisable to tie the vessels before removing the head of the bone for the reason that a certain retraction takes place when this large substance is removed and some of the vessels are more difficult to secure with certainty than when they are tied before the bone is removed.

WRIST RESECTION BY THE LATERAL INCISION.

BY STEWART L. M'CURDY, M.D.,

OF PITTSBURG, PENNA.

Orthopedic Surgeon to Columbia and Presbyterian Hospitals ; Professor of Orthopedic and Clinical Surgery in the West Penn Medical College.

CASE I.—Miss R. S., aged 35 years, while in bed vomiting, with hand grasping the side of rail, experienced great pain in her wrist. The accident was followed by the usual symptoms of sprain but they gradually intensified. At the end of two months the wrist remained twice its normal size, slightly œdematous, and very painful. The general strength was reduced. The wrist had been treated as a sprain, rheumatism, and a dislocation, and a possible fracture.

After an examination the one diagnostic point that stood out from the foregoing enumerated conditions was pitting on pressure; with the other symptoms, a diagnosis of periostitis of the carpal bones was clear, and an operation was advised.

The X-ray examination revealed little except a slight clearing in the upper part of the cuneiform.

The internal lateral incision was made. This is done by beginning the incision just palmar to the styloid process of the ulna, and extending it downward to the base of the fifth metacarpal bone. This makes an opening scarcely an inch long. The only structure of importance in the wound is the extensor carpi ulnaris. The opening is sufficiently large to admit the index-finger, a Volkman spoon, bone forceps, or chisel. Through the wound thus made I succeeded in removing all of the carpal bones except the pisiform and with a chisel cut off the styloid process of the radius. Tincture of iodine was used to sponge out the cavity. Packing controlled the hæmorrhage. The wound was closed in two months with a perfect recovery. A dorsal splint made for the purpose was used for several months. The structures across the wrist-joint gradually shortened, as may be seen by examining the X-ray (Fig. 1.) taken several months after the operation.



FIG. 1.



FIG. 2.



FIG. 3.

CASE II.—Miss L. H., aged 21 years, who had been suffering for several years with pain and swelling in the wrist, which greatly increased in size and developed into a typical spindle-shaped tubercular joint. The tubercular process in the bone liquefied, and extended into the soft structures about the joint, especially in the neighborhood of the ulna, the enlargement extending up the forearm about twelve inches. The abscess opened spontaneously and had been discharging for several months. An X-ray picture was taken which, as can be seen (Fig. 2), showed a disorganization of the semilunar and cuneiform bones.

The operation consisted of a free incision into the internal surface of the carpal bones, the incision being made between the tendons of the flexor and extensor carpi ulnaris. Through this opening the disorganized bones were found and removed. As the X-ray picture (Fig. 3) shows, the entire semilunar and cuneiform, a portion of the pisiform, and a portion of the scaphoid, or the first row of carpal bones, were practically destroyed.

The lateral opening is undoubtedly a great improvement over the operation recommended by Mintar, which means practically a cleavage of the anterior surface of the wrist, destroying all of the flexors of the hand. This unilateral incision is undoubtedly to be preferred to Lister's bilateral longitudinal incision, and of course the Langenbeck dorsal radial incision involves to a great extent the extensor tendons of the fingers, and in this way impairs the functional usefulness of these structures. The unilateral incision has been practical in these two cases, and furnishes perfectly free entrance into the joint for the removal of all the carpal bones, and the heads of the forearm bones, for that matter, without including in the field of operation one tendon or an artery large enough to require attention.

THE USE OF A STEEL COMB FOR DISSECTION IN THE AXILLA.

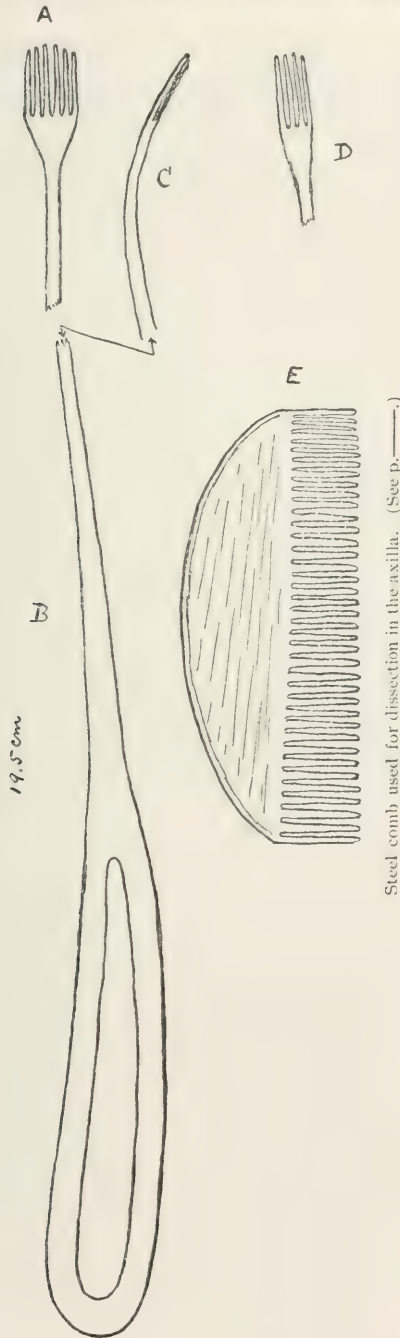
BY HOWARD A. KELLY, M.D.,

OF BALTIMORE, MD.

I HAVE used for three years past a little instrument, figured on adjoining page, in cases of breast cancer in making the axillary and subclavicular dissection. The process of dissection of these regions with forceps and knife is both slow and unsatisfactory, and unless a great deal of time is given, it is more or less imperfect. Moreover, there are deep tissues which are not reached at all with the knife. I have found that with a pair of forceps and the little metal comb (See Fig. A, B) I could very rapidly draw the fat out from the depths away from nerves and great vessels. The little instrument has also proved to be of great value in skeletonizing the vascular trunks, near their points of origin from the larger trunks, for the purpose of ligation. When cleaned in this way the nerves and vessels are at once readily differentiated.

The character of the dissection thus made in the peripheral parts of the field is, I believe, more perfect and less liable to distribute any cancerous elements than that made with the knife.

The length of the comb is 19.5 cm. The end is made of little steel prongs about 1 cm. long, terminating in a fine rounded point as shown at A. The instrument is curved at its end as seen at C. If B were joined on to C, the instrument would then be shown as it appears in outline. I sometimes use a smaller prong (D) for finer work. I have tried to dissect the peripheral parts of the breast in its lower portion with a larger, coarser instrument, like that shown in E, but as it has not yet proved satisfactory, I simply mention the experiment.



POSTOPERATIVE COMFORT.¹

BY WILLIAM G. LE BOUTILLIER, M.D.,

OF NEW YORK,

Surgeon to the J. Hood Wright Memorial Hospital.

To secure the comfort of patients after operations can readily be shown to be as desirable as to secure freedom from pain during actual operative procedures. The dread of pain to be endured during the performance of operations has almost disappeared from the community, but there persists an impression that subsequent to operations a considerable degree of real pain must be borne. This impression doubtless causes a good many people to decline operations that are advisable but not imperative, so that such operations are deferred to times that may be less favorable, or are not done at all. The result is that the subjects of some infirmities continue to go about less fit for active life than they might be, or exposed to dangers that could be entirely removed. That unnecessary pain after an operation has a depressing effect on a patient, is a statement that does not need to be supported by extended argument. Such depression may in serious cases be sufficient to be of determining import as regards recovery.

That the ordinary amount of pain and discomfort after operations can be reduced, I have found in my own practice. The main modifications of the previous plan of treatment after operations, which I now endeavor to have carried out, are the subject of this paper. The employment of these changes makes the patients much more comfortable than they were a few years ago.

The points of change chiefly refer to relieving thirst, and pain; procuring more rest; stimulating more freely; feeding more and earlier; and the posture of the patient.

¹Read before the New York Surgical Society, March 14, 1906.

Thirst.—At the conclusion of an operation of any extent, the patient receives at once an enema of hot saline solution, to which, if there is any shock, half an ounce to an ounce of whiskey is added. In the majority of cases the salt solution is given alone, as a matter of routine, to supply fluids. Such an enema is repeated every three hours until there is no thirst or the stomach is able to retain fluids and nourishment; or the pulse is of good rate and quality. The amount given varies from a pint to six ounces at each time, in any case being gradually reduced. These enemata of saline solution are usually discontinued before it is necessary to use an enema for the purpose of moving the bowels.

Beginning five or six hours after anæsthesia is suspended, fluid by the mouth is allowed in moderate, and soon, in almost unlimited, quantities. It is given at such temperature as the patient prefers. It is *allowed*, but patients do not as a rule ask for much. When the stomach contents are thick or very acid, water appears to act as a simple diluent so as to diminish the general discomfort and to reduce the frequency of efforts to vomit. From a suggestion of Dr. McCosh I have learned to permit the use of water freely instead of using the stomach-tube, even in cases where there are extensive peritonitis and considerable vomiting.

Patients suffer very little, sometimes not at all, from thirst, in such cases as previously were constantly begging for relief. It is believed that the elimination of the anæsthetic occurs more quickly and that the secretion of urine is less interfered with.

Stimulation.—In order to increase the general resistance to infection, early free stimulation is employed in addition to the saline and whiskey already mentioned. Subcutaneous injections of strychnine gr. 1/30 to gr. 1/20, repeated every three hours, are usually given for 12 to 24 or even 36 hours, after which the same drug is given by the mouth, until the patient's general condition is satisfactory.

Pain.—When there is a probability that there will be much pain, morphine is given before the effect of the anæsthetic has

passed off. It is repeated in sufficient doses to keep the patient comfortable. This is done even in cases of peritonitis. The results reported in cases of peritonitis when treated by Ochsner's method have shown the value of intestinal rest, and I do not hesitate to use morphine after operations to relieve all pain so far as possible. It does not appear that morphine impairs the blood or lymphatic circulation of the peritoneum or intestines, and if it does not, I can see no contraindication to its use.

Laxatives.—Borrowing again from Ochsner's teaching, little magnesium sulphate is used to secure movements of the bowels. That salines have any specific influence on peritonitis does not appear to be the case. No attempt is made to have every patient's bowels move by a time-table, daily or otherwise. The wide individual variations in the frequency with which this function is performed, need not be worried about or altered because a patient has had an operation. The rectal tube is used in the customary way when necessary for accumulated gas in the cæcum. Inflamed intestines have more time to rest when laxatives are not given for 36 or 48 hours. Then an enema is given; or an enema follows a single dose of calomel (grs. $\frac{v}{y}$ to $\frac{iv}{iv}$), or some mild laxative, as for example the pill of aloes and mastich; or a laxative alone is given.

Posture.—The position of postoperative cases is changed frequently when mechanical conditions permit it. It appears to me to be as desirable to change the position of unconscious and weak surgical cases frequently, as it is to do so in cases of typhoid fever. In such cases, lying a long time on the back should be avoided as much as possible, particularly when they are unconscious, on account of the greater likelihood that in this position mouth secretions or vomitus may be inhaled. It may be questioned whether the improvement in results noted when Fowler's position is used, is not due rather to improved pulmonary and circulatory conditions than to modifications in the amount of toxin absorbed from the peritoneal cavity. I have never used Fowler's position, nor its opposite suggested by Clarke of Johns Hopkins; but I do slightly raise the head and

upper part of the body with a back rest, and frequently change the patient's position onto the side. With a sufficiently firm abdominal bandage, there has been no occasion to fear a reopening of abdominal wounds. Back-aches and tender spots from pressure are very much diminished in frequency and in intensity.

Dressings.—The chief remaining source of postoperative pain comes from the dressings. Roughness and carelessness and lack of manual dexterity on the part of wound-dressers are errors that can be remedied. The patient usually knows what is done at the dressing, and from this is apt to form his own opinion as to the skill employed at the operation which he neither saw nor felt. When applying dressings at the close of an operation it is often wise to think of how they are to be removed, if the latter is to be done painlessly. When gauze is stuffed into a wound, its removal should be effected under an anæsthetic, or delayed until it has been loosened from the tissues with which it is in contact. Drainage-tubes and cigarette-drains (gauze wrapped in gutta-percha tissue) can usually be removed practically painlessly. Ordinarily they do not need to be reintroduced and their former sites can be cleansed thoroughly without any pain, by flushing with saline solution introduced through a small glass tube or a rubber catheter. It is needless to say that the patient should be comfortably disposed in a good light, and that injured limbs should be steadily held by assistants during the entire dressing. The plan for the new dressing should be prepared before any part of the old one is disturbed.

Rest.—In general I endeavor to arrange the after-treatment of operative cases so that the patients shall not be disturbed at frequent intervals for various purposes. They need time to rest and if possible should sleep a good deal. In most cases one can secure three-hour periods without disturbance for anything. The rest and the sleep (the latter secured by drugs when necessary), certainly favor the recovery of the patient.

Food.—Patients whose intestines are not worried by

salines and whose bellies are not distended by gas, are usually pretty ready to eat, and they are allowed food early and in such quantities as they can take. Solid food often seems to agree better than liquids. Of course while there is vomiting, and the stomach digests nothing, no food is given by mouth. The more septic the case the more need for feeding it, to increase the resistance to infection.

Long staying in bed is not resorted to unless the patient is too enfeebled to do otherwise. The practice of getting post-typhoidal septic cases out of bed and feeding them, deserves careful consideration on the part of the surgeon.

It is of the utmost importance to adapt the treatment to each individual case, and abandon so far as possible purely routine treatment.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, March 14, 1906.

The President, DR. GEORGE WOOLSEY, in the Chair.

STAPHYLOCOCCUS BONE INFECTION.

DR. CHARLES N. DOWD presented a boy, 9 years old, who when he came under Dr. Dowd's care in April, 1903, complained of spasm and tenderness in both hip-joints. The chief point of interest in his previous history was that he had had abscesses above the ankle and also in the forearm.

The case developed all the symptoms of ordinary hip-joint disease. An abscess formed in the left thigh, which was aspirated, and following this the function of the hip-joint was restored. Subsequently, another abscess developed in the vicinity of the right hip-joint; this was also opened and drained. There were a number of recurrences, and the patient was sent to the country. In October, 1904, there was involvement of the left humerus; an abscess developed which led down to the epiphysis, and necessitated removal of the interior of the upper end of the bone. There were recurrent abscesses in the right thigh, and recently a large abscess in the back. On cutting down upon it, a large amount of pus was evacuated which contained a pure culture of staphylococcus pyogenes aureus.

The X-ray findings of the patient showed the difference from tuberculosis much more than the clinical history did. A picture which was taken a year and a-half ago showed extensive involucrum formation about the upper part of the shaft and the neck of the right femur, and considerable similar formation about

the neck of the left femur, whereas the joint itself did not look like a tubercular joint. This involucrum deposit had been steadily diminishing ever since, and at the present time was much less marked than it had been, and at the present rate the bone would soon resume its normal size and shape. The motion in the left hip at the present time is normal; that in the right hip is moderately restricted. The motion in the left shoulder-joint is normal.

Dr. Dowd referred to other similar cases which he had seen and to an article on the subject of staphylococcic disease of the hip-joint by Von Bruns, which describes more than one hundred cases of osteomyelitis affecting the hip which had been observed in the Tübingen clinic. These cases are apparently usually considered to be tubercular.

A second patient, shown by Dr. Dowd, was a young man of 17, with a bone abscess in the interior of the left tibia, which had never broken through the surface, and from which the patient had had symptoms for several years. When he first saw the patient, a year ago, there was a hard swelling of the tibia about four inches below the knee, with moderate tenderness on pressure. The patient had for the previous nine years had pain in this locality. At the onset he was confined to bed for two or three weeks and during a portion of each year, usually in the spring, he would also be confined to bed for a few days, and during the rest of the year he was unable to go about as other boys did and usually felt some tenderness in his leg. He habitually wore a protective bandage, and had to abstain from the ordinary games of boyhood. An X-ray picture taken at that time showed thickening of the bone about the cortex of the tibia, and a clearer place within, which was diagnosticated as an abscess. Several pictures were taken and all showed the same condition. No operation was permitted for another year, but about a month previously, on cutting into the tibia, the abscess was found; It was about as large as a large hickory-nut and contained soft purulent material, from which pure cultures of staphylococcus pyogenes aureus grew. The cortex of the bone was very hard, and at least half an inch of hard bone had to be chiseled through before the abscess was reached. The very slow course of the staphylococcus infection in both of these cases seemed worthy of note.

DR. FREDERICK KAMMERER presented a woman, 41 years old, who first came under his care in July, 1895. Her history dated back for two years, and consisted essentially of frequent attacks of renal colic on both sides. On the right side she had a large tumor corresponding with the site of the right kidney. The urine was filled with pus, and the woman was in a septic condition.

On July 10, 1895, Dr. Kammerer exposed and incised the right kidney, and evacuated a large amount of pus. In the pelvis of the organ a large calculus was found, which could only be removed by breaking it up. The patient's condition was such that a nephrectomy was deemed inadvisable. The kidney was therefore drained, and about two months later, after an unsuccessful attempt to induce the fistula to close, the kidney was removed. The wound thereupon healed kindly. The urine still contained a small amount of pus, but there was no further pain on that side.

On February 21, 1897, the patient was suddenly seized with a pain in the left side. For several days her temperature ranged about 103, with very scanty urine, and severe pain over the left kidney. On February 21 she passed about 200 c.c. of urine. On the following day a still smaller quantity was voided, and on February 23, at 5 A.M. complete anuria set in. After fifteen hours had elapsed, Dr. Kammerer cut down on the kidney. He found the pelvis of the organ, as well as the ureter, much distended. He incised the latter about one inch from its junction to the pelvis, and evacuated a quantity of purulent urine; then, on inserting the finger, he found three small stones in the pelvis of the kidney, which he removed. With a probe he also made out a calculus in the ureter, about four inches from the junction of the ureter with the pelvis, and after freeing the former from the surrounding tissues he was able to push the stone up into the incision and extract it. Drainage of the kidney was resorted to through an incision into the substance of the organ, and for several weeks the course of the case gave rise to some anxiety. On the fifth day the packing was removed, and five catgut stitches were inserted to close the incision into the ureter. There was still slight leakage at that point, but in the course of a month, both the incisions into the ureter and the kidney tissue had closed, and the further recovery of the patient was uneventful.

Eight years had elapsed since the second operation, and the patient still remained in excellent health. With the exception of a few pus corpuscles, the urine was quite free, and her pain had entirely disappeared.

In a second case of renal calculus, which was reported by Dr. Kammerer, the patient was a musician, 42 years old, who came under his observation last summer. He gave a history of severe and frequent attacks of renal colic, dating back for two years, with pus and blood in the urine. His symptoms were easily referred to the right side.

When Dr. Kammerer first saw the patient, on June 25, 1905, the man's temperature had ranged between 103 and 104 for several weeks. The urine contained a large amount of pus, and the enlarged right kidney was distinctly palpable. Upon exposing it, and during an attempt made to free it, the kidney ruptured at its convexity, and a large amount of purulent urine escaped. No stones were found in the kidney or pelvis, but on introducing a probe into the ureter, a calculus was located at a depth of about eight inches from the rent of the kidney. On account of the patient's condition, no attempt was made to dislodge it at the time, but two weeks later, through the usual incision around the crest of the ilium, the ureter very much distended was laid bare and incised, and the calculus extracted. The incision in the ureter was immediately sutured, and the kidney was drained. The patient made a slow but satisfactory recovery, and finally the wounds closed without the necessity arising for a nephrectomy, which it had been feared would be the case.

About six weeks after the operation, the patient was suddenly seized with chills, his temperature rose to 105, and he complained of pain over the left kidney. The organ rapidly enlarged, and the patient's condition became very alarming. High fever, dry tongue, delirium, etc. When the left kidney was finally exposed, it was found to be twice its normal size. Upon incising it, a large amount of purulent urine was evacuated. No stone was found in either the kidney or its pelvis, but, as on the opposite side, and at about the same distance, an obstruction was discovered in the ureter. The patient was in a condition of profound sepsis, and no attempt was made to further determine the nature of the obstruction. On the day after the operation

he passed a small stone spontaneously, which had apparently been located at the time of the operation in the ureter perhaps pushed down towards the bladder. For two weeks the patient's condition was very serious; then he began to improve, and had since remained in excellent health.

The cause of the infection of the second kidney in this case, Dr. Kammerer said, was rather obscure. The symptoms developed about six weeks after the first operation, when the patient was up and about. He had never been catheterized.

In both of these cases, Dr. Kammerer said, he followed the method of securing a satisfactory exposure of the kidney by doing a preliminary resection of the twelfth rib.

POSTOPERATIVE COMFORT.

DR. WILLIAM G. LE BOUTILLIER read a paper with the above title (for which see Page 106).

DR. ANDREW J. MCCOSH said that Dr. Le Boutillier might have done well to extend his timely and interesting paper so as to cover the preoperative stage, which included the repeated enemas, the scrubbing and shaving, which many patients dreaded more than the operation itself. While this preoperative treatment was not as severe as it was a few years ago, its machine-like routine was still open to much improvement.

The speaker said he was thoroughly in accord with Dr. Le Boutillier's advocacy of giving the patients plenty of fluids by rectum, and personally he had found that frequent enemas and irrigations with Kemp's tube were very satisfactory, especially in the severe abdominal cases where there was much thirst.

Dr. McCosh said that in his opinion, the postoperative comfort of the patient could be considerably enhanced by certain modifications on the operating table. For example, the insertion of *tight* sutures, embracing a good deal of the skin, and forming the so-called step-ladder cicatrix, frequently gave rise to much pain. There was no reason for embracing such a wide area of tissue, nor pulling the stitches so tightly.

In regard to postoperative feeding, Dr. McCosh said he would not resort to it quite as early as was advocated by the reader of the paper. A few days' starvation was usually not such a great hardship, providing fluids were not withheld. Too early

feeding was apt to give rise to colic and the formation of gases. The less food that was given during the first two or three days, the better. The albumen orangeade and lemonades which were so much employed by nurses, he thought often gave rise to colic pains and abdominal discomfort.

DR. GEORGE WOOLSEY said he had found that position made a great difference in the postoperative comfort of the patient, and with that object in view he frequently ordered the Fowler position, especially in stout patients, although it was not originally intended for that purpose. In a recent case of abdominal hysterectomy the foot of the bed had been elevated with considerable discomfort to the patient. He had the blocks removed from the foot of the bed, and the patient felt so much more comfortable that she herself suggested that the head of the bed be raised.

GANGRENE OF THE LEG IN A CHILD.

DR. GEORGE WOOLSEY presented a specimen removed from a child, twenty-six months old. Nine months ago there was a history of an attack of measles, with apparent recovery. About a month ago there was a sudden onset of fever, cough and prostration, which was first regarded as a bronchitis and then as pneumonia. Without any distinct crisis, there was improvement on the seventh day. Two days later, the right leg became blanched and quite cold, and on the fifth day thereafter the color changed to a bluish-black. On the seventeenth day of the disease, when Dr. Woolsey first saw the child, the respirations ranged between 45 and 60; there was some cough, with signs of consolidation in the left lower lobe, and the patient's general condition was not good. The temperature was elevated at night; there were no sweats. The gangrene of the right leg extended to just below the knee; the toes were shriveled; there was a well-marked stationary line of demarcation. Four days later the patient was removed to the Presbyterian Hospital and Dr. W. P. Northrup, who examined the patient on that day, still detected signs of unresolved pneumonia in the left lower lobe.

Five days later, as the gangrenous area was beginning to separate an immediate operation was advised, and because of the fact that the gangrene extended so close to the knee, the amputation was done just above that joint. The cause of the gangrene

proved to be a thrombus of both tibial arteries, extending up into the popliteal for $\frac{1}{4}$ inch, and the vein was also more or less thrombosed. The operation was done three days ago, and the case was apparently progressing favorably.

The patient was also seen by Drs. A. Jacobi and Henry Koplik, neither of whom had ever seen this complication occur in a child in the course of pneumonia. Dr. Jacobi had seen it after measles, and it is not uncommon in adults after typhoid fever, and is sometimes seen in them after pneumonia.

RENAL CALCULI.

DR. GEORGE WOOLSEY presented specimens removed from a woman, 42 years old, whose family history was negative. There was no venereal history. She had been a resident of the United States for seventeen years, and was the mother of seven children, all living, and had two miscarriages. After the second of these, she was curetted. Her last child was born four years ago.

Her present trouble began about six years ago with frequently recurring attacks of dragging pain on the right side of the abdomen; this was never very sharp, and did not radiate either up or down. It was relieved by rest. There was no history of vomiting.

Examination of the urine showed a marked trace of albumin, with considerable pus (about one-half of one per cent. in bulk), and a few red blood-cells. There were no casts. The blood count was normal. No tubercle bacilli were found in the urine. There was no frequency of micturition. An X-ray was taken, but the plates were poor and showed nothing.

On examination, the right kidney was readily palpated, and freely movable. It was enlarged, but not nodular. Through a lumbar incision the organ was exposed and incised along the outer border, and three calculi were found and extracted. Two of these, originally one which had been split in two, had rested in perfect apposition, and by attrition their opposed surfaces had been worn smooth. One had projected down into the ureter. There was slight infection of the kidney, but its lower half seemed to be entirely normal, and the kidney was therefore drained and not removed. The patient was making an uneventful recovery.

Stated Meeting, March 28, 1906.

The President, DR. GEORGE WOOLSEY, in the *Chair*.

TREATMENT OF FRACTURE OF THE FEMUR IN A CHILD.

DR. THEODORE DUNHAM presented a girl, three years old, who had sustained a fracture of the left thigh seventeen days previously. The case was shown to illustrate the improved splint devised by Dr. Dunham for the treatment of the femur in young children, which was described by him in a paper on the subject read before this society in December, 1904.

The special advantage claimed for the splint was that it secured extension to the broken thigh without keeping the child in bed, which meant a great deal to the general health of the patient. This splint did not interfere with an infant's sitting on the mother's lap and nursing, the diapers could be changed when necessary, etc.

The splint consisted, essentially, of a plaster-of-paris spica bandage about the pelvis and upper section of the thigh, and a second plaster-of-paris bandage extending from the toes to the knee. Into each of these splints a thin piece of flat iron was rigidly incorporated by means of plaster-of-paris, which for that purpose should have about the consistency of thick cream. In order to secure extension, it was only necessary to have one person take hold of the pelvic girdle, and another of the leg, and make traction in the line of the femur. The upper end of the piece of iron that was incorporated into the lower plaster bandage overlapped the lower end of the iron that was incorporated into the plaster spica above, and by means of the traction caused one to slide on the other two clamps; the irons were then firmly held together, maintaining the extension.

By means of this splint, which could be readily removed and replaced if the conditions demanded it, the necessary extension was secured; it also prevented any rotary displacement of the lower fragment, and angular deformity could be corrected by coaptation splints.

Dr. Dunham said he had thus far treated seven cases by this method, and all of them with excellent results. His youngest patient thus treated was two weeks old: a case of the fracture of the femur occurring at birth. The fracture had been neglected for two weeks and a large traumatic tumor had formed, but in spite of that the result was excellent. The method did not interfere with massage treatment, if that was indicated, nor with the taking of an X-ray picture, and the thigh was always free for inspection and palpation; but above all else, the greatest advantage was that the patient could be carried about, and could sit comfortably in a steamer chair. An anæsthetic was unnecessary in the application of this splint.

CHARCOT'S DISEASE OF THE TARSAL JOINTS.

DR. JOHN A. HARTWELL presented a man aged 40 years who applied to the Out-Patient Department of Bellevue Hospital to get treatment for a swelling about the ankle. He gave a history of having had syphilis twelve years ago, when he was under treatment for about ten months. Subsequent to that he had had no symptoms referable to this infection. In December, 1904, he had had an open sore on the sole of the foot which he said was a corn, and which had become infected by being cut. Following this he had a severe infection in the whole of the foot which necessitated multiple incisions and drainage. The condition continued until April, 1905, before the wounds were entirely healed. He then first noted that the ankle joint was swollen and stiff, it was, however, not painful, and he was able to walk on it. This condition about the ankle has continued ever since, sometimes being more marked than at others, but never entirely disappearing. He has at no time suffered any pain since the infectious process cleared up. His general health has been entirely good. Physical Examination, March 14th 1906: General nutrition good. No distinct conditions that can positively be assigned to syphilis. Examination of pupillary reflexes shows a slow and rather feeble reaction to light, and a prompt reaction to distance. The knee jerks are both present, though not pronounced. Plantar reflexes present. There is no evidence of Romberg's sign; and the gait is not ataxic. The lower extremities show disturbed pain sensation to the level of Poupart's liga-

ment, but neither tactile or temperature sensation is in the least impaired. No evidence of impairment of the muscular sense is made out. Examination of the foot shows the scars of the old incisions for the infectious process, but none of these seem to have extended beyond the metatarsal portion of the foot. The scar on the sole looks more like that of a perforating ulcer, than from a superficial infection. Left ankle measures in circumference $18\frac{1}{2}$ inches, the right 12 inches. Distance between the two malleoli shows an increase of one inch on left side over that on right. The swelling thus indicated seems to be rather uniformly distributed throughout the tarsus. The motion in the ankle and tarsal joint is not restricted and is not painful. Palpation elicits a marked bony crepitus over the head of the astragalus and over the dorsal surface of the scaphoid cuboid and external cuneiform bones. There is a distinct bony fragment palpable at the astragalo—scaphoid articulation, and the breaking down of the arch allows a marked bulging of the cuboid into the sole of the foot. All these conditions are distinctly shown by the radiograph (Fig. 1) which shows a considerable disintegration of the bones in question. Dr. Hartwell showed the case as one of probable Charcot disease of the tarsal joints in a patient whose only symptoms of tabes were a suspicion of the Argyle-Robertson pupil, and a diminished knee jerk, and a pain sense disturbance with a previous etiological factor in the form of syphilis. The patient had been seen by a competent neurologist, who expressed the opinion that the condition was one of early tabes. The lesion was a rare one, in that the tarsal joint is not often involved and the joint conditions are uncommon previous to marked manifestations of tabes dorsalis.

DR. L. W. HOTCHKISS said he had seen but one case of Charcot's joint involving the ankle.

DR. WOOLSEY said he had never seen the ankle involved in such a case.

DR. HARTWELL, in closing, said that about a year ago, at the Lincoln Hospital, he saw a somewhat similar case. The patient was a man about 60, a sailor, who showed no evidences of syphilis, and gave no history of that disease. There were no actual signs of tabes. One ankle joint was apparently disorganized, as in this case, and it had been so painful that the man had been unable



FIG. 1.—Charcot's disease in tarsus, showing disorganization of joint structure.

to leave his bed for two months. Upon cutting into the joint, it was found to be totally disorganized, so that amputation of the foot was deemed advisable.

An examination of the specimen showed an osteitis, with destruction of the bones at the joint. There was no nerve lesion nor other demonstrable etiological factor. The case was classified under the general term of arthritis deformans. The man had never had any acute symptoms in the joint, and the other joints of the body were apparently normal.

STENOSIS OF THE PYLORUS IN INFANCY.

DR. ARTHUR L. FISK read a paper with this title (for which see page 1).

DR. WOOLSEY said that in a case recently reported by Dr. John Rogers there was apparently very little thickening of the pylorus, and the speaker said he understood that that was a feature in many of these cases. In Dr. Rogers' case, as he recalled it, a sound could be introduced through the pylorus, although all the characteristic symptoms of stenosis were present. The speaker asked whether extreme hypertrophy of the parts seemed to be the rule in these cases?

DR. C. A. WILLIAMS said he had assisted Dr. Rogers at two operations for the relief of pyloric stenosis in two young infants, and in both of them the pylorus was nearly as large as double the size of an adult thumb; it was hard, like cartilage, and there seemed to be scarcely any lumen. There was considerable shrinkage of the pylorus after death in the one patient who died; and the pyloric opening admitted a 20 French sound, a large part of the previous stenosis being evidently due to spasm.

As to the choice of operation in these cases, Dr. McWilliams said he was convinced that a gastro-enterostomy was a much easier and safer operation than pyloroplasty. In the latter even in an adult it is difficult to be certain as to the size of the channel left after the suturing, and this difficulty is much greater in an infant. In two of nine recorded cases of pyloroplasty in infants, there resulted subsequently complete pyloric obstructions. Gastro-enterostomy is the preferable operation, because firstly, it is better to operate on normal than on morbid tissues; secondly, feeding

can be commenced at once after gastro-enterostomy; thirdly, the time required for the operation is no longer, if as long; and fourthly, the remote results after gastro-enterostomy have been proved to be highly satisfactory, while as yet we do not know that those after pyloroplasty are as good.

DR. HARTWELL reported a case of a woman, 60 years old, who about two months ago complained of pain on the left side of the abdomen. Shortly afterwards she began to vomit, and this continued, more or less persistently, for three or four weeks, in spite of lavage and medical treatment. She had vomited some blood, and an examination of the stomach contents showed a diminution of hydrochloric acid.

As the patient was rapidly losing ground, and carcinoma of the stomach was suspected, the abdomen was opened. There was some questionable thickening about the pylorus, with slight dilatation of the stomach, but the diagnosis of carcinoma was not confirmed. No cause for the persistent vomiting was found. A posterior gastro-enterostomy by the suture method was done. The woman made a perfect recovery from the operation, and for five or six days felt relieved; then the vomiting recurred; it was persistent, but not of the type that suggested a vicious circle. Nothing further was done, and the patient died about a month after the operation.

At the autopsy it was found that the gastro-enterostomy wound had healed perfectly, with an opening large enough to admit the thumb. There was no evidence of a vicious circle. The pyloric opening readily admitted the index-finger, although it seemed somewhat resistant. No cause was discovered for the vomiting or death. There was no brain lesion; no nephritis; no evidences of liver disease.

DR. FISK, in closing, said that in all cases of true pyloric stenosis, hypertrophy had been found. In cases of apparent stenosis, that improved under medical treatment, the symptoms were attributed to spasm of the pylorus, and not to true stenosis, with thickening. It is very difficult to distinguish between these two conditions. In cases of true stenosis, it is important to make the diagnosis as soon as possible, and operate early.

In regard to choosing between gastroenterostomy and a pyloroplasty in dealing with this condition, Dr. Fisk called atten-

tion to the fact that Dent resorted to the latter operation in all of his cases, and all recovered. Dent claims that pyloroplasty can be done more quickly than gastroenterostomy. And Dr. Fisk considered it preferable from every possible standpoint,—physiological, anatomical, and surgical.

Dr. Fisk said that about a year ago he saw a young woman with symptoms very similar to those in the case reported by Dr. Hartwell. He did an exploratory laparotomy, and found thickening of the pylorus. Her vomiting, which had been very persistent, was permanently relieved by a Finney operation.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting held March 5, 1906.

The President, JOHN B. ROBERTS, M.D., in the Chair.

EXPERIENCE WITH MECKEL'S DIVERTICULUM.

DR. JOHN B. ROBERTS read a paper with this title (for which see page 87).

DR. JOHN H. GIBBON referred to three cases in which he had met with a Meckel's diverticulum. In one case a diagnosis of general peritonitis was made and at the operation a gangrenous Meckel's diverticulum constricting the small intestine was found. This case was reported in the *American Journal of the Medical Sciences*. The other two diverticula were met with in operating for other conditions. Our idea as to the frequency of Meckel's diverticulum has changed greatly since the abdomen has been more frequently opened. No doubt this malformation was in the past frequently the cause of peritonitis.

DR. WILLIAM J. TAYLOR mentioned two cases of Meckel's diverticulum one of which he had reported to the Academy, the other to the Johns Hopkins Medical Society. The latter occurred in a child who was supposed to have had three attacks of appendicitis, the symptoms resembling those of a brother who had a few months previous been operated upon for that condition. When the abdomen was opened a globular mass protruded and examination revealed a large diverticulum which was twisted on itself three times, the entire mass being gangrenous. It was cut away at the base and the gut united, the result of the operation being very satisfactory. In the case reported at the Academy, the diverticulum was a long fibrous band that completely

encircled the gut and passed through the mesentery. By gradual contraction it had narrowed the intestine. This patient also made a good recovery.

COXA VALGA.

DR. JAMES K. YOUNG reported the case of a boy, eight years of age, who was brought to him for examination January 27, 1906, by Dr. M. A. Roberts. The patient had a fall about five years before, after which his mother noticed that he walked "crooked." The deformity has been increasing of late. When he falls down he has difficulty in getting up again.

The boy stood on his left leg with right knee thrown forward and inward, and spine curved, with the convexity to the right, and with the left shoulder depressed. In walking he limped on the right leg and the over-development of the quadratus muscles is noted. In standing the crease of the buttocks is inclined to the left, and the abdomen is pendulous and prominent. In the lying position there is slight lordosis and the pelvis is tilted upward on the right side. The right leg is apparently longer than the left, although the bony measurements are the same. In the right hip flexion is abnormal, the thigh is carried outward in adduction during flexion, and adduction is then limited. The adductor tendon is smaller. In the left hip all the movements are normal, and adduction is normal. The right limb is adducted upon the pelvis. Flexion of both knees shows the femur of the right limb to be a little longer than that of the left, and the lordosis is not entirely lost until both thighs are flexed upon the abdomen. The spine is flexible in every direction, and there is no osteitis present. There is an increased development of the quadratus lumborum muscle and also in the latissimus. There is pain upon motion in the groin above the insertion of the adductor muscles, and this point is also sensitive to pressure.

Skiagram shows the angle of neck of femur on right side to be decreased to about 100° , the normal angle in the adult being about 130° , but varying in individuals, the variation being in an inverse ratio to the stature and to the development of the pelvic bones.

On February 8, 1906, Dr. Young divided the adductors from their pelvic attachment, encased the leg in plaster, and adducted

the limb for two weeks. The patient will wear an elevation on the left foot, with the expectation that the weight falling at a different angle upon the neck will correct the angle of deformity.

This has occurred in a similar case of coxa valga in a child who was $2\frac{1}{2}$ years old in March, 1904, when he was brought for treatment. The biceps tendon in this case was divided and by the use of a high shoe upon the other foot the angle changed.

SABRE BLADE DEFORMITY.

DR. JAMES K. YOUNG reported two cases of sabre blade deformity.

Case I.—A girl, eleven years of age, applied to the Polyclinic Hospital December 1, 1904. She was a tall, healthy-looking girl. When she was one year old she fell out of bed and was unconscious for a time. When two years old the mother noticed that she dragged the leg. She wore braces for a year. Has not worn them since. Five weeks previous to date of applying at hospital she stepped suddenly down from a flight of steps at school and the leg gave way under her. On her way home she fell again. The leg was very painful and she reached home with difficulty. Was unable to walk from that time until coming to the hospital. Examination of the leg at this time showed a bending of the tibia, and the end of the lower fragment of the broken fibula could be felt under the skin. Skiagraph showed fracture of lower tibia and fibula, and of upper third of tibia, with a small amount of callus. Ends of fibula not approximated. Forward bending of tibia. Tibia also showed areas of softening.

December 10, the ends of the fibula were excised and an attempt made to unite them with silver wire, but the bone was too soft and too much diseased to hold the wire. About $\frac{3}{4}$ of an inch of bone was removed and the periosteum sutured together. The bone was brought into a straight line. Nothing was done to the tibia. A subsequent skiagraph showed growth of bone within the periosteal sheath, and union of the fibula had occurred. Examination at this time (1906) shows the fracture still ununited.

Case II.—A boy, fifteen years of age, applied to the Polyclinic Hospital July 16, 1904. In the early part of 1903 while walking he fractured the tibia above the malleoli. Leg was not set at time of injury. Tibia was deformed for eight years.

When he applied at the hospital his ankle was fixed with the foot at right angle to the leg. There was considerable pain in the leg, increased upon standing and walking. Skiagraph showed typical sabre-blade deformity. He was fitted with brace, and after four weeks reported that he had much less pain.

DR. DEFOREST WILLARD said that five days previous he operated on a colored boy eight years old who had marked sabre-blade deformity. Several years previously the tibia had given away but not knowing that fracture had occurred the boy had continued walking and when seen by Dr. Willard the condition well illustrated the remarkable compensatory power of bones. The fibula had remained intact and had developed to three times its normal size; the tibia had atrophied and absorbed. The lesion was treated as an ununited fracture, the tibia being cut down upon and wired, while a wedge from the fibula was resected.

DR. HENRY R. WHARTON said the interesting point in the cases of sabre-blade deformity reported was the occurrence of fracture. In his experience, fracture is a rare complication of the condition. In a number of cases upon which he had operated he found the bone dense and the compact portion increased in thickness. The treatment he finds most satisfactory in these cases is to make an incision in the soft parts from epiphysis to epiphysis and then lay open the bone to the medullary cavity throughout its entire length. This can be done with a circular saw propelled by a dental engine or with a Hey's saw. This method of operating shows the thickness of the bone as before mentioned, the hard part being from one-eighth to one-fourth inch thick. Having thus exposed the marrow throughout its entire length, the external wound is closed without drainage. Generally there is relief of pain. Several cases have been relieved in this manner after a long treatment with potassium iodid had proved ineffective.

HEMIPLEGIA FOLLOWING OPERATION FOR APPENDICITIS.

DR. H. R. WHARTON reported the case of a boy, aged eight years, who was admitted to the Girard College Infirmary, in May, 1905, suffering from bromidrosis, with excoriation about

the toes and feet. He was exceedingly nervous and became hysterical when the feet were dressed. One week after admission he complained of pain in his right iliac fossa; no rigidity, very slight tenderness on pressure. These abdominal symptoms passed away after the use of an enema. Two days later the abdomen became markedly distended, and there was pain and tenderness, with slight rigidity of the muscles over the right iliac fossa, but the pain was never severe at any time. The temperature at this time was 99° and the pulse 108. Six-hour leucocyte counts showed a gradually-increasing leucocytosis—13,000, 20,000, 22,000, 28,000.

The appendix was exposed by an incision through the outer edge of the right rectus, and was found to be much inflamed, and enlarged about three times its normal size. It was firmly adherent to the omentum, was gangrenous, and perforated at its distal end, and contained a good sized concretion. An abscess, circumscribed by adherent bowel, extended into the pelvis. The appendix was removed, and the abscess drained with glass tube and gauze drains. The patient did well after the operation, there was free purulent discharge from the wound for a few days, and all drainage was removed from the wound at the end of the first week.

On the third day after the operation the patient, who had been previously bright, answering questions and talking freely, suddenly became quiet, and examination showed inability to protrude the tongue or to speak. There was ptosis of the right eye, facial paralysis on right side, complete paralysis of motion of the right leg and partial of the right arm, with diminished sensation in both these members. Babinski reflex present in right foot, patella and ankle; clonus reflexes normal. The patient had no marked elevation of temperature, never being over $100.2-5^{\circ}$ during the first week, and his abdominal condition was entirely satisfactory.

At the end of the third day, after the appearance of the hemiplegia, the patient began to improve, the voice returned and the sensation was normal in the limbs. Motion was regained first in the fingers and toes, and at the end of the sixth day he could use his hand fairly well, but made no attempt to do so unless his left arm was tied to his side. Improvement of the motion in the leg was slower, reflexes negative, except for a slight ankle clonus.

The nurse in charge of the case reported that when visited by members of his family he apparently redeveloped the paralysis of the arm and leg, and could not be induced to move either member.

The abdominal incision was healed after the twenty-third day, and from this time the patient was encouraged to use the limb in walking, and in a few days walked quite well. He developed typhoid fever during the early fall, and made a satisfactory recovery from this disease. In December, 1905, he was in good condition, with no evidence of impairment of function in the right arm or leg.

When Dr. Wharton saw the case a few hours after the development of the hemiplegia, he was inclined to attribute it to embolism, but the rapid disappearance of some of the symptoms, beginning in three days, and the previous nervous condition of the patient, the development of marked nervous symptoms on slight provocation before the operation, and the redevelopment of the symptoms of paralysis of the arm and leg when visited by members of his family, suggested the possibility of hysterical hemiplegia. Although many of the symptoms could be explained as hysterical manifestations, a careful study of the case rendered it difficult to explain all of them upon this hypothesis, notably, the presence of facial paralysis, ptosis, and the Babinski reflex, which all point to an organic lesion.

DR. WHARTON SINKLER saw the patient a few days after the development of the nervous symptoms, and sent the following report of his observations:

"The case was probably one of thrombosis of one of the vessels supplying the motor area, but there is reason for the belief that the patient was also suffering from hysteria. The reason for this opinion was that hysterical facial paralysis is so rare that it may be excluded. In addition to this the boy had ptosis of the same side and complete paralysis of motion in the right leg and partial in the right arm.

The Babinski reflex was present and ankle clonus was present to a slight extent on the right side. These phenomena indicated the existence of an organic change. The rapid recovery is explicable on the supposition that the collateral circulation was rapidly established. Rapid recovery in the hemiplegias of children, occurring after acute illnesses, is not unusual. That

some of the symptoms alleged by the relatives of the boy were due to hysteria, there can be little doubt."

STRICTURE OF THE ŒSOPHAGUS

DR. H. R. WHARTON presented a patient in whom gastrostomy, followed by retrograde dilatation, was performed more than five years ago for stricture of the œsophagus.

Robert B., seven years of age, was admitted to the Children's Hospital, October 13, 1900, suffering from difficulty in swallowing and regurgitation of food. He had four weeks previously swallowed a solution of lye, which he mistook for milk. At the time of admission he was emaciated, and seemed unable to swallow any food; even liquids were regurgitated, unless taken in very small quantities.

Upon examination with an œsophageal bougie, a stricture of the œsophagus was located, $9\frac{1}{4}$ inches from the line of the teeth, through which it was found impossible to pass even the smallest bougie. The patient was given nutritious enemata, and for a time improved slightly in weight under their use.

On December 17, as it was found impossible to pass any instrument through the stricture, and as he was losing rapidly in weight and was greatly emaciated, gastrostomy was done, and the patient was fed through the gastric fistula. He improved rapidly under regular feeding through the fistula, and ten days later he was anæsthetized and an attempt was made to pass an instrument through the mouth without success. A small flexible catheter was then passed through the fistula and into the œsophagus, and after a number of attempts it was passed through the stricture and appeared in the pharynx. A stout silk ligature was attached to the extremity of the catheter, and it was withdrawn through the fistula. A small rubber drainage-tube was fastened to the end of the ligature, and it was well stretched and drawn through the stricture until its end appeared in the pharynx. The string attachment to the rubber tube was brought out of the mouth and secured to the cheek by a strip of plaster, and the lower end of the rubber tube was secured outside of the fistula by a safety-pin. At intervals of two or three days rubber tubes of increasing size were attached to the tube and drawn through the stricture and secured as described as above. At the end of three weeks the rubber tube was removed, and dilatation of the

stricture was continued by passing bougies through the mouth. When the stricture had been dilated to about 26 French scale, he could swallow food quite well.

As he was able to take food well by the mouth, and the skin in the region of the fistula was excoriated, it was decided to operate for the closure of the gastric fistula. This was done by circumscribing the fistulous opening by an incision and dissecting it down to the abdominal muscles. The orifice of the fistula was incised at each end, and the mucous surfaces inverted and secured in this position by silk sutures; another layer of sutures next secured the aponeurotic structures over this, and the skin incision was finally closed with sutures.

There was a little leakage through the line of sutures for a few days, but this then ceased, and the wound healed firmly. The boy left the hospital in August in good condition, and at this time was able to swallow ordinary food without difficulty.

The patient was not seen again until November, 1905, when he was admitted to the Medical Ward suffering from fever, supposed to be typhoid. This proved not to be typhoid fever, and he was discharged in a few days. At this time he was able to take ordinary food without difficulty.

The procedure employed, gastrostomy, followed by retrograde dilatation of the stricture with rubber tubes, was most satisfactory in this case, and should be resorted to when dilatation of the stricture by bougies passed through the mouth is impossible. The modern operations of gastrostomy, which aim to produce a fistula without leakage, and do not give sufficient access to the stomach for the passing of bougies are not applicable in these cases.

TETANUS AFTER AMPUTATION FOR GUNSHOT WOUND OF FOREARM.

DR. H. R. WHARTON reported the case of a young man, aged eighteen years, who received a gunshot wound of the forearm at close range, with No 6 shot, on October 27, 1905. The skin and subcutaneous tissue for a space of several inches, about three inches above the wrist, were torn away, but the bones were not injured. He was seen by Dr. Carpenter, who controlled the bleeding and sutured the tendons. On the third day after the accident gangrene of the hand developed, and he was

sent to the Presbyterian Hospital. At this time the patient had a temperature of 103° , was delirious, and was septic.

The forearm was amputated three inches below the elbow, and immediately the patient's general condition improved. This improvement continued until December 4, when he complained of stiffness about jaws, which was followed by the rapid development of marked symptoms of tetanus. He was immediately given injections of tetanus antitoxin, and at the same time chloral hydrate and bromide of potassium in full doses. In spite of the treatment he became progressively worse, having from four to five convulsions in the twenty-four hours. At the end of a week he had taken fifteen injections of antitoxin, 30 c.c. each. At this time the injections of antitoxin were discontinued, and the chloral hydrate and bromide of potassium were continued. To control the convulsions the inhalation of nitrite of amyl, ether and chloroform were used. The latter drug was the only one which proved satisfactory. Morphine was also used freely to relieve pain and secure sleep. The patient was also given large quantities of liquid nourishment. For a week after discontinuing injections of antitoxin, the convulsions were frequent and severe, but in the third week diminished in frequency and disappeared entirely in the fourth week. The patient gradually improved in strength and was discharged on December 16, 1905.

Dr. Wharton said that his experience in the treatment of tetanus by antitoxin had not been encouraging. The recovery in this case, he thought was due to the fact that they were able to support the patient until the disease had run its course, relieving pain and securing sleep by the use of morphine, chloral and bromide, and to prevent death from spasm of the respiratory muscles by the use of chloroform during the convulsions.

INFECTIONS OF THE KNEE-JOINT.

DR. DUDLEY P. ALLEN, of Cleveland, Ohio, read a paper entitled "A Study of Infections of the Knee-Joint, with Their Treatment."

In beginning the paper he explained that it was called a "study" because the subjects to be presented were still under consideration and definite conclusions had not been reached with reference to them. The paper was based upon material gathered at Lakeside Hospital during six or seven years, but

work bearing upon the subject in hand had only been carried on during the last three or four years. The material under treatment showed that there were numerous cases of infection of the knee-joint in which the chief manifestations were swelling with effusion, pain and tenderness on pressure or motion. To such cases has commonly been applied the term of articular rheumatism. Many of the cases were admitted to the medical ward with this diagnosis. Some of the cases yielded quickly to treatment by the salicylates, the pain rapidly disappearing. Other cases were unaffected by such treatment, and a study of such cases was instituted. The paper, however, took up certain other classes of cases.

The first class of cases to be considered was those of infection of the knee-joint as a result of external wounds or trauma. In a number of cases of very severe infection an attempt had been made primarily to save the joint by drainage and irrigation. After it was evident that this had failed, a more radical method of procedure had been instituted. The knee-joint had been opened by a transverse incision across the front of the joint, separating the ligamentum patellæ, and by two incisions on either side, opening the joint to its upper extremity. After thoroughly clearing out the joint, the entire cavity was filled with iodoform gauze, with the joint in the flexed position. This secured absolutely perfect drainage. As it became evident that the acute infectious process was under control, the iodoform gauze was removed, a smaller amount returned, and the leg was gradually brought into the extended position. By this means the patient's life was saved and the leg was preserved, although the knee-joint was perfectly stiff.

This method of procedure was recommended in cases of grave infection where it was evident that the patient's life, or at least his limb, was jeopardized by any more conservative treatment, the fact being pointed out of the seriousness of infections of the knee-joint. Several cases of unusual gravity were reported which had been treated by this method.

As opposed to this radical method of treatment, a case was reported of suppuration of the knee-joint, a pure culture of streptococcus being obtained. In this case the joint had been washed out with 1 to 40 carbolic acid, and then injected with an emulsion of iodoform in glycerine. This treatment had been

repeated several times, and the patient recovered, with a joint which could be flexed to a right angle. The possibility was suggested that the further study of causes of infection of the joint might show that while some cases require the most radical treatment others might be treated in a more conservative manner.

Two cases were reported of infection of the knee-joint with pure cultures of pneumococcus. One of these cases had been treated as acute articular rheumatism, having been in the hands of a physician of large experience. Immediately upon admission to the hospital the joint was aspirated and thoroughly opened. The pus obtained gave a pure culture of pneumococcus. Incision failed to relieve the condition and the thigh was amputated, but the patient died. A careful post-mortem failed to disclose a diseased condition elsewhere.

Cases of this sort seem to emphasize the importance of early positive diagnosis.

Tubercular infection of the knee-joint was the next subject to be considered. The aid to be gained in such cases by means of X-ray photographs was pointed out and illustrated. It was also pointed out that in many cases early diagnosis by ordinary means was extremely difficult, due to the fact that the appearances were not always characteristic, and the X-ray photograph gave no assistance. Some cases were reported which had been seemingly very successfully treated by the injection of iodoform emulsion. It was pointed out, however, that statements with reference to cases of this kind must be very conservative, and could be convincing only after long observation, since the tendency to recurrence of trouble in a knee after tubercular infection was well known. A strong probability was thought to exist of benefit from the injection of iodoform by thoroughly established results gained elsewhere. The writer pointed out a series of cases of tubercular disease of the vertebræ, with the accumulation of large amounts of pus. In these cases after aspiration and injection of iodoform emulsion, in some cases the process being repeated as high as ten times, a considerable number of permanent cures had been obtained. If such results could be obtained in tuberculous abscesses, having their origin in the spinal column, it seems strongly probable that beneficial results might follow a similar treatment of the knee-joint.

Following the cases treated by injections of iodoform was a

series of cases of tuberculosis of the knee-joint, in which the joint had been laid widely open. In one such case in which a positive diagnosis had seemed impossible, a movable body could be felt. On opening the joint this was found to be attached at one extremity to the synovial membrane surrounding the joint. There were other similar movable bodies of small size. These were removed and on microscopic examination they presented positive evidence of being tubercular. The writer insisted upon the value of early diagnosis thus gained by incision of the joint. Diagnosis by other means often proves unsatisfactory, since the material aspirated from tubercular joints often failed to give cultures of bacilli which could be discovered by microscopical examination, and the inoculation of animals also proved, in a certain number of cases, unsatisfactory as a means of diagnosis. While not prepared to take too radical a position, the writer had a growing inclination to the incision of questionable joints of this kind, since in a series of cases no evil results had been encountered, and the results obtained had seemed more rapid and more positive than those gained by other means.

In conjunction with the aid given in the diagnosis of tuberculosis by the use of the X-ray apparatus, the writer reported other cases of floating cartilage. In one of these a considerable amount of effusion was present in the joint, and a diagnosis was difficult. By the aid of the X-ray a floating cartilage was located and removed, and the fact established that it was not tubercular in character.

Another class of cases described were those of gonorrhoeal rheumatism. Although multiple joints may be involved, it was the writer's opinion that the joint which suffered most frequently, and probably most seriously, was the knee-joint. A careful study of the history of the cases, together with a thorough examination, usually gives at least a strong suspicion as to its nature. Such cases untreated often result in marked stiffening if not in ankylosis of the joint. This is sometimes associated with marked deformity. The writer had treated a number of cases of the kind by a thorough washing of the joint with carbolic acid. In some, in addition to this, an emulsion of iodoform had been used. The results obtained seemed much superior to those secured from less radical methods.

The last class of cases to be considered were those commonly

classified as acute articular rheumatism, in which little if any benefit was found from the administration of salicylates. The close resemblance which these bore to others which are known to be due to a definite infection is such as to arouse a strong suspicion that they are also infectious. The results obtained in such cases are often long delayed and most unsatisfactory. Some cases of this kind had also been treated by washing and iodoform injection. Recently, in a series of cases, the joint had been opened by a long incision parallel to the patella, laying the joint open throughout its entire length. These cases had either been swabbed out with a 95 per cent. solution of carbolic acid, or carbolic acid had been poured directly into the joint. As soon as this had come in contact with every part of the joint, the joint was thoroughly washed with a 95 per cent. solution of alcohol, in order to limit the effect of the carbolic acid. On opening joints of this kind the synovial membrane had been found greatly thickened and reddened, and the intra-articular fringes in a similar condition, and also very greatly hypertrophied. Careful bacteriological and microscopic examinations had failed to disclose any organisms. The clinical appearances, however, were such as to lead one strongly to suspect their presence. In a small number of cases treated by this method, the results at the time of the report have been most encouraging, sufficiently so to warrant the further trial of the method.

After a consideration of the various sources of infection the writer's conclusion was that although it was perhaps too early to make a final statement with reference to the points under consideration, enough experience had been gained to warrant the more radical treatment of infections of the knee-joint. The joint should no longer be considered a closed cavity which might be opened only with great danger to the patient. Under proper precautions it should be opened as quickly as any other closed cavity of the body, and its condition ascertained. By early interference much can be learned and many cases might receive prompt and efficient treatment with the hope of speedy and positive benefit, which otherwise would be left to conditions more chronic and much less hopeful.

DR. DEFOREST WILLARD said that as regards prompt and radical treatment in infections of the knee there can be no question. If we can determine the diagnosis by means of the X-ray,

by aspiration, and by bacteriological investigation, there is no reason for delaying operation. Early and thorough opening of the joint is most important. How open this shall be depends upon the character and virulence of the infection. In the most virulent cases the joint should be laid entirely open so that every portion may be cleansed and drained thus avoiding amputation. Other less virulent cases need not be so thoroughly opened. A stiff knee is much better than an amputation through the thigh. Hence in infections radical measures are indicated. As to aspiration and injection of iodoform, Dr. Willard is not in accord with Dr. Allen, as the results after such procedure have not been satisfactory. Especially in the case of tuberculous joints has he been sadly disappointed by these injections. He now employs aspiration only as a diagnostic method or as a step preceding opening and drainage. In the case of gonococcal infections, the open treatment is the only one likely to yield good results, as such cases are liable to the rapid formation of adhesions unless the joint be opened and thoroughly cleansed. The majority terminate satisfactorily if the joint is opened; otherwise ankylosis is common even if early motion is made. This is particularly true of the knee-joint.

Tuberculin as a diagnostic agent has proven very unsatisfactory. As to the use of carbolic acid and alcohol in rheumatism, Dr. Willard is glad Dr. Allen has taken up the theory of infection in these cases. What is ordinarily called rheumatism is often an infection, a great number of cases being called rheumatism when they are not rheumatism at all. For instance gonorrhœal rheumatism ought never to be thus misnamed. Even cases of true rheumatism are instances of auto-infection, and the open treatment as detailed by Dr. Allen is along the right line.

DR. WILLIAM L. RODMAN said that his experience accorded with that of Dr. Allen in regard to the injection of iodoform. From its use he obtains very good results. As with any other procedure, disappointment from its use will now and then be met, but he has depended upon it, particularly in lesions of the wrist-joint where erosion, excision, or other operative measures are not particularly desirable or satisfactory. In two cases of wrist-joint tuberculosis he secured absolute relief by injecting iodoform. It is a measure that should be repeated if necessary, failure being often due to the fact that it is not persisted in.

Dr. Rodman strongly advocated an aggressive policy in the treatment of tuberculosis of joints. Surgeons in general have too long been afraid to do things in these cases. A tuberculous joint is difficult to infect and one may do almost as he pleases with such a lesion if he practices scrupulous antisepsis or asepsis. He has often opened such a joint and performed an atypical resection and thorough erosion without producing infection and without the operation resulting in ankylosis. In one case of knee-joint tuberculosis the entire inner condyle was removed and the joint drained for six weeks. Perfect use of the part resulted. The man is an enthusiastic sportsman and walks during his shooting expeditions, moving the joint as well as can any other person. In streptococcic infections, he believes that the plan detailed by Dr. Allen may be proper in the more virulent infections. It must be remembered that there are streptococcic infections and streptococcic infections, there being between them a marked difference in severity. Most radical treatment may be necessary in some cases, but in two instances of as virulent infection as appears possible Dr. Rodman had obtained good results from a middle course of treatment. One case was that of a plumber who ran a rusty nail into his knee-joint. He was treated by a physician for several days, during which a most violent infection developed. The patient insisted that the nail was not in the joint, though Dr. Rodman suspected its presence. When the joint was opened a pint of pus was evacuated and the headless rusty nail secured. Free drainage was instituted and, although a most extensive streptococcic infection spread from the knee to the hip, inducing an intense erysipelatous condition with sloughing of large masses of tissue, a good result was finally obtained. The knee can now be bent past a right angle and the man can walk as well as he ever did. The second case was that of a boy who because of a suppurative osteomyelitis had one leg amputated above the knee. Suppuration of the opposite knee developed. The joint was irrigated daily for four weeks with sublimate solution, and the leg was saved with a movable joint. From these cases it will be seen that through-and-through drainage, with a tube, will accomplish much, and is to be preferred to more radical measures which make ankylosis a certainty. Dr. Rodman does not now operate on so-called rheumatic joints, though he may in the future.

DR. RICHARD H. HARTE said all surgeons recognized that in grave diseases, as typhoid fever, pneumonia, and like affections, there is apt to be infection of the joints. Where infection of the joints exists the best method of treatment is to open and drain. He has opened joints when they were involved by tuberculosis and by other infections, using iodoform emulsion; he believes in the efficacy of this agent. He also frequently leaves iodoform drains in for a long time. Dr. Harte endorses the very radical method advocated by Dr. Allen for the treatment of virulent streptococcic infections. This is the standard to which he believes surgeons are going to come, and adherence to it will result in saving limbs which formerly have been amputated. Regarding joint effusions, as in articular rheumatism, they at times follow trauma; synovitis then develops, followed by infection and finally rheumatoid arthritis. Dr. Harte was particularly interested in Dr. Allen's negative findings in cases of articular rheumatism. In conclusion he stated his belief that the best working rule regarding joint infections is to operate on all doubtful cases. This may appear radical but it is better than to let the cases drag along for an indefinite period, until an extensive joint involvement has taken place. He sees *comparatively* little danger in thoroughly opening and draining the joint and removing the foci of infection.

DR. HENRY R. WHARTON said his experience with iodoform injections had been similar to that of Dr. Willard; this agent was more freely used years ago than it is now. Regarding the wide-open treatment of streptococcic joint infections, he has been content with free drainage consisting of multiple incisions and many drains. Functional results are satisfactory. In young children particularly he has seen recovery with good function. In cases of acute epiphysitis with pus, free drainage often leads to recovery with a useful joint; the older writers called attention to this result. Regarding gonorrhœal arthritis, he has treated a few cases by incision and many by aspiration. The latter procedure should be employed early and when repeated often leads to the restoration of good function of the joint. He has never used carbolic acid or iodoform injections for this affection.

DR. JAMES K. YOUNG cited an instance of wide-open treatment of streptococcic infection of the knee-joint in a man of

forty-five years. An incision had previously been made across the patellar tendon. He opened the joint freely, removed the patella and drained. The joint did not become ankylosed and the patient wears a brace. In his experience iodoform is of value in small joints, even the wrist and ankle; in the larger joints it does not give good results. He has abandoned its use in the hip and knee-joints, because in them it generally acts as a foreign body and has to be removed.

TRANSACTIONS

OF THE

CHICAGO SURGICAL SOCIETY

*Joint Meeting with the Chicago Medical Society,
February 28, 1906.*

DR. D. W. GRAHAM, Vice President, in the Chair.

POSTOPERATIVE ILEUS.

DR. JOHN M. T. FINNEY, of Baltimore, Md., read a paper with the above title (for which see June ANNALS, page 870).

ADYNAMIC AND DYNAMIC ILEUS.

DR. JOHN B. MURPHY said that he defined ileus not as a pathologic entity, but as a train of symptoms, and that train of symptoms consisted of four essential elements, one or the other preponderating in its influence. These were (1) pain in the abdomen; (2) nausea and vomiting; (3) meteorismus, (4) coprostasis,—that is, a stasis of the intestinal contents, whether it be gas or feces.

He subdivided ileus into three great divisions, namely, adynamic ileus, dynamic ileus, and mechanic ileus. Under adynamic ileus he included all of the conditions that are due to the absence of power of propulsion. Under dynamic ileus he included the two conditions which we recognize, where the obstruction is due to an excess of power, excessive contraction of the muscular wall. Under mechanic ileus he included all the mechanical conditions, whether of the strangulation or obturation variety, which impede the advancement of the contents of the intestinal canal in a mechanical way.

The intestinal tract is a long tube, thirty-odd feet in length, made up of a muscular wall, having flexions or flexures of varying size, and with valves. The function of that tube is not only to absorb and secrete, but to propel its contents, and it is the matter of propelling its contents that really concerns surgeons. In the matter of propulsion, the conditions which contribute to the stasis or to the absence of propulsion, may include four different varieties of conditions. First, those of spinal origin; second, those interfering with the nerve-supply in the mesentery; third, those interfering with the wall of the intestine and the muscle; and, fourth, the infiltration of the muscle itself. Those of spinal origin relate to adynamic ileus. It is not an uncommon experience to see a case of spinal adynamic ileus,—that is, a patient with a fracture of the spine in the upper dorsal region, with an enormously distended abdomen, with the absence of peristalsis, with inability to secure bowel movements by all ordinary means. It is the same as occurs in gunshot wounds; it is the same as occurs in stab wounds at the spine. In that class of cases the differential diagnosis is neither difficult nor of great importance; but in the class of cases involving injuries to the mesentery, where extensive operations have been performed on the mesentery, or where there are extensive transverse wounds of the mesentery of bullet origin, ileus is practically always fatal.

In the removal of tumors from the mesentery—fibromata, myomata, lipomata, or others,—if the greatest care is not exercised in separating the mesentery from the tumors, and in the ligation of the blood-vessels or nerves of the mesentery, a paralytic ileus will be determined which will lead to a fatal termination.

As an example of an afferent nerve lesion, he cited a case seen at the Cook County Hospital many years ago, in which there was a bullet wound in the mediastinum, which did not strike the spine, there was no paralysis of the lower extremities, no injury except in the mediastinum. The patient had a complete paralytic ileus of the entire intestinal tract.

The patient was a policeman who, in following a burglar upstairs, was shot, the bullet having passed in behind the clavicle and downward. When Dr. Murphy saw him on the sixth day after the accident, his abdomen was enormously distended; there was protrusion of his bowel on account of the distention of his

abdomen; his respiration was compromised; there was complete absence of peristalsis. On placing the patient on his left side there was flatness to a certain line; on turning the patient on the opposite side, there was flatness on a certain line, with resonance on the other side. What was the conclusion? It was that the bullet had passed down through the diaphragm and had penetrated either the stomach or intestine, and the peritoneal cavity was full of fluid. A laparotomy was done, and the peritoneum found absolutely free from fluid. When he was turned on the table the fluid in his paralyzed intestine flowed to the most dependent portion. When turned on the other side, with abdomen open, the fluid flowed over the side as it would through a rubber tube, so complete and perfect was the paralysis of his intestine. Strange to say operation cured him. Peristalsis set in within two hours after the operation. He began to have free bowel movements; gas passed off, and he recovered.

Adynamic ileus, correctly so named because it is an absence of power in the intestine, is sometimes referred to under the head of reflex. It is incorporated in the classification given by neurologists as a reflex phenomena; the first of the causes is strangulation of the omentum. How many general practitioners have been called to treat a case of strangulated omentum, with pain, absence of peristalsis, distention of the abdomen, nausea and vomiting, and coprostasis, or inability to get a bowel movement. Every general practitioner has seen such cases. Every surgeon has been confronted with such, where, within the first forty-eight hours, illness comes on, with evidence of obstruction to the lumen of the bowel of mechanical origin, and examination and laparotomy showed there was nothing whatever in the hernial canal but a portion of omentum.

Strangulation of the omentum produces a reflex paralysis of peristalsis. By placing the stethoscope on the abdomen in such a case, the practitioner will find that there is not only an absence of peristalsis in the local area, but an absence of peristalsis over the entire abdomen for a period of time varying from twenty-three or twenty-eight hours to forty-five or forty-eight hours after the strangulation, depending upon its completeness.

Hepatic calculus may be a cause. The term hepatic calculus is used in preference to cystic-duct or gall-bladder calculus. The

colic that occurs with hepatic calculus is difficult to differentiate from mechanical obstruction, because there are present four of the essential features of a mechanical ileus, viz., pain, nausea and vomiting; absence of peristalsis, with distention of the bowel coming on as the result of the paralytic condition, and coprostasis while the pain is severe.

One of the very difficult things to diagnose differentially is the impaction of stone in the cystic duct. When a stone first passes into the cystic duct, the patient has a pain that is colicky in type, with absence of peristalsis, and it is not easy to make a differential diagnosis. A practical point now in connection with the pain of cystic-duct obstruction and the pain of mechanical ileus, is that with the pain of cystic-duct obstruction, there is an absence of rumbling or sound in the peritoneal cavity. With the pain of mechanical obstruction there can be heard borborygmus not only with the stethoscope, but the by-stander can hear it standing at the bedside with the back toward the patient. One is a paralytic ileus stopping the intestinal wave and producing distention, meteorismus, pain, absence of bowel movements by reflex causes, producing reflex paralysis of the intestine; the other, the colic of mechanical ileus; first, a pain that is endeavoring to bombard or remove mechanical obstruction in the wall of the bowel and is accompanied by borborygmus. Renal calculus has less effect upon the muscular activity of the intestinal tract than hepatic calculus, but it still has a considerable effect and is sometimes difficult of differentiation. Ovarian compression is not infrequently diagnosed as mechanical ileus.

The speaker remembered very well having confounded adynamic ileus with diaphragmatic pleurisy, or with the pleurisy of deep lobar pneumonia. Again and again, the surgeon is called to see cases in children in which there is an enormous persistent distention of the belly; pain is complained of over the abdomen; no bowel movements. There is absence of peristalsis; there is the same deathlike stillness when the stethoscope is placed on the abdomen that there is in the other types of paralytic ileus. But there is always present in this class of cases what is never present in primary mechanical obstruction of the intestinal tube, and that is elevation of temperature.

There is another class of cases in which the manifestations

of ileus are very pronounced due to the ligation of pedicles. Since the practice of ligating pedicles *en masse* has ceased, surgeons are having much less vomiting after operations, and fewer cases of paralytic ileus than formerly. The practice of ligating a large pedicle, formerly in vogue, he believed had caused many of those reflex symptoms which had followed operations in the lower part of the abdomen.

Gastric tetany is another condition of reflex ileus or of paralytic ileus that is mistaken for intestinal obstruction. The enormous distention of the stomach to one, two, three, four or five quarts' capacity immediately after operation leads to the belief that the patient has obstruction of the intestine below, when the entire condition is due to over distention of the stomach, and the patient can only be relieved of vomiting, of the distention and distress, by passing a stomach-tube and withdrawing or liberating the enormous quantity of fluid that is accumulated in the stomach.

Peritoneal trauma is another cause of paralytic ileus, and a very important one. The surgeon who produces much peritoneal trauma is certain to have excessive mortality. The peritoneum is a sensitive organ, and every trauma committed in an operation tends to produce distention and paralysis of the intestine after the operation is completed.

The next class of cases which fortunately are not so difficult to differentiate, but which are more common than the mechanical type of ileus, are those in which there is a train of symptoms associated with sepsis. First, with local peritonitis, that is to say, a peritonitis that surrounds the gall-bladder, the appendix, or a tube in its acute manifestations. In the examination of these cases one has for the differential diagnosis the additional significance of temperature. Temperature is always present in the early stages. The paralysis of peristalsis is always present in the early stage of an acute sepsis. In the strangulation stage of appendicitis there are all the manifestations of paralytic ileus—absence of peristalsis, with a colic. In general peritonitis there is a condition which for years was difficult to differentiate from mechanical ileus, the general peritonitis producing obstruction to the bowel in proportion to the infiltration of its wall.

The embolic type of paralytic ileus is due to two causes. First, interference with the nerve supply; and, second, ischemia.

In thrombo-phlebitis there is a slower type of development, where there are abscesses in the veins of the liver and spleen. There is rarely great meteorismus. The rule is a flattened belly, and not a distended abdomen. As symptoms, pain, nausea and vomiting. These occur just the same in the paralytic as in the mechanical obstructions. Meteorismus is as pronounced in the early stage of paralytic, and particularly in the peritoneal or inflammatory type, as it is where there is mechanical obstruction. Coprostasis is the same. Borborygmus is always absent in the paralytic type. Borborygmus is one of the most pronounced manifestations of mechanical obstruction of the intestinal tract, and a stethoscope examination in a case of mechanical obstruction gives more light than a stethoscopic examination of the chest for a lesion of the lung. The absence of sound means, what? Absence of muscular contraction. Mechanical ileus, up to the first, second, third, fourth, and fifth day, has declining frequencies in manifestations of pain or colic; it has declining frequencies in borborygmus; but borborygmus can be excited at any time by massage of the abdominal wall.

Temperature and leucocytosis.—Temperature is never a primary symptom in mechanical ileus, not even in the type presented in children—intussusception. He believed at one time that leucocytosis was going to be of enormous value in the differential diagnosis; that the infective type would show a high leucocyte count, while the mechanical type would show a low leucocyte count. He had been greatly disappointed. He had seen a 36,000 leucocyte count (differential) in mechanical ileus. He had seen a 7,000 leucocyte count in a case of septic peritonitis, so that he had ceased to place any particular value in the differential diagnosis as to the number of leucocytes.

STRANGULATION ILEUS.

DR. ARTHUR DEAN BEVAN said that credit was due to Schlangé who in 1889 presented a general classification of ileus of great value in a clinical way, the division of ileus into two great groups—paralytic ileus, which covers the ground of dynamic ileus, so-called, or adynamic ileus, and mechanical ileus.

Paralytic ileus essentially means peritonitis or sepsis;

mechanical ileus some mechanical form of obstruction. Schlange went further and made this classification, namely, the division of mechanical ileus into strangulation ileus and obturation ileus. The first question the speaker asked himself, when called to the bedside of a patient with ileus, was, Is this paralytic ileus, is it strangulation ileus, or is it obturation ileus? Because upon a correct diagnosis and classification of the particular case depends an intelligent treatment. Briefly, if it is paralytic ileus, many of the cases are best handled without operation. If it is strangulation ileus, it means absolutely an immediate operation just exactly as a case of strangulated hernia means an immediate operation of a radical type, because in the strangulated form there is not only obstruction of the bowel, but interference with the circulation. If it is obturation ileus, it may or may not mean immediate operation. If it does mean operation, it may mean a lesser operation than the radical removal of the mechanical obstruction at that time, namely, an enterostomy.

Strangulation ileus is best studied from the standpoint of a strangulated hernia. It is a form of ileus which comes on as a strangulated hernia does, with sudden onset, with shock, with pain, with obstruction of the bowel, with vomiting, with later tympany, and, if unrelieved, peritonitis usually, and death. It is, however, at the beginning free from temperature.

The diagnosis, as a rule, can be made early if the surgeon had a clear mental picture of just what strangulation ileus means. It means such a condition as this within the abdomen: A loop of intestine is strangulated as a loop of intestine is strangulated in the scrotum; this very soon becomes paralyzed and distended. There is in almost all cases of strangulation ileus a period at which, if the loop of intestine is of fair size, and the abdominal wall not too thick, the strangulated loop can be determined by the local distention, and the absence of peristalsis. At the same time, in strangulated ileus, there is not a paralysis of the afferent bowel, but the afferent bowel makes a great effort to overcome the obstruction, in that way causing pain, symptoms of peristalsis sometimes visible and invariably the passage or rumbling of gas which can be heard with the stethoscope. If general practitioners are to learn anything about ileus, they must learn how to recognize the difference between those forms which de-

mand immediate operation and those which can be watched for a reasonable length of time in order to confirm the diagnosis. In the strangulation type immediate operation is always indicated.

One word in regard to the character of the operation and the conditions commonly found as the cause of mechanical ileus when the abdomen is opened. First, strangulation from bands. That is the most common type which is met with in mechanical ileus, and as the most common cause an old appendix lesion furnishes most frequently the bands which produce the mechanical obstruction. These bands may be between loops of the bowel or may be a part of the omentum.

As a second frequent cause occurs a Meckel's diverticulum, and it is rather astonishing to find that Meckel's diverticulum is the cause of probably more than five per cent. of cases of intestinal obstruction. It is a very common cause of intestinal obstruction. Just as Meckel's diverticulum can produce obstruction, so also can a long appendix, or adhesions to a tube. The next most common cause is probably volvulus. This, of course, is limited almost entirely to the sigmoid or to the ileum with a long mesentery, and occasionally to the entire transverse colon.

Of the internal hernias commonly met with, may be cited especially small hernias which give no evidence of their existence from external examination, at the common positions of hernia such as those in which the hernias are engaged in the femoral ring, in the internal inguinal ring, at the umbilicus, and hernias in unusual positions, such as the obturator foramen, the sciatic foramen, etc.

The forms of ileus which are described as due to strangulation in the retroperitoneal fossæ are quite infrequent. They do occur, however, and must be kept in mind. Cases occurring in the intersigmoid fossa, in the pericecal fossa, in the duodenal fossa, in the foramen of Winslow, are rather rare surgical curiosities, and no one has had any considerable experience with strangulation due to hernias of this type. Strangulation ileus may occur from rents in the mesentery and omentum and other abdominal organs, as, for instance, a rent in the uterus. Occasionally a case is reported in this last group of rupture of the uterus, with a knuckle of bowel, or loop of bowel, passing through the rupture, the rent being caused sometimes by an abortion. Sometimes

injuries of the uterus after curettage will be the cause of such an obstruction.

Dr. Murphy has included under the paralytic form of ileus thrombosis and embolism of the mesenteric vessels. Possibly he is right. In many classifications, however, this is included under the strangulation variety, because of interference with the circulation. Personally he had not met such a case. They are rare. Dr. McArthur had one such case comparatively recently in which the superior mesenteric artery was involved, and all the small intestines which are supplied by the superior mesenteric ganglia were black or gangrenous. The patient of course died as the result of the lesion. The lesion is either an endarteritis or embolism from some cardiac valve lesion, or a thrombus of a mesenteric vein from sepsis or from traumatism. There is a rather interesting anatomical fact in connection with a thrombus or embolism of the superior mesenteric artery and vein, namely, that either of these vessels is capable of producing by its being blocked up gangrene of the entire small intestine supplied by them. If, however, the lesion which produces obliteration of the vessel takes place slowly as a gradually-growing tumor, this does not necessarily follow. There are a few cases on record where the inferior mesenteric has been able to take care of the blood-supply of the entire intestinal tract, where the superior mesenteric has been gradually blocked, without resulting gangrene and resulting ileus.

As to strangulation ileus. The proper treatment of a case by the medical men is the making of an immediate diagnosis, and then urging immediate operation. There can be no doubt of it. Case after case of mechanical ileus dies because an early diagnosis was not made, because early operation was not done, but in which early diagnosis and early operation would have saved life. The same is true of strangulated hernia. How many patients with strangulated hernia would die if they were operated on two or three hours after strangulation? Not a much larger per cent. than from the operation for radical cure of hernia. The same thing is almost true of strangulation ileus if it is operated on in the first few hours after the attack. When the patient has this sudden onset, with a picture of shock resembling that of a strangulated hernia, he demands immediate operation. In fact, any medical treatment

of the individual is a waste of time. Nothing but an immediate operation is indicated. It is the only hope and it gives a patient much hope. What do the figures show? If operated on forty-eight hours after strangulation has taken place, the prognosis is bad; between twenty-four and forty-eight hours, the prognosis is fair; inside of twenty-four hours the prognosis is good. That is the key to the situation. The operative treatment for strangulation ileus is the radical removal of the strangulation in the early cases. In the late cases,—and we find unfortunately we are confronted not infrequently with cases in the late stages, where the abdomen is distended, where the patient is septic, where there is evidence of peritonitis,—radical operation is out of question, and the operation which should be done under gas anæsthesia or Schleich infiltration anæsthesia, is an enterostomy, with a glass tube inserted into the first distended loop of the bowel, usually in the right flank, and held in position by a pursestring suture which will wall off and prevent infection until plastic inflammation prevents any extension to the general peritoneal cavity. Undoubtedly, enterostomy offers considerable hope even in these late cases, and is the operation of choice rather than a radical procedure.

OBTURATION ILEUS.

DR. WM. E. SCHROEDER said that in the classification of Schlangé, obturation ileus, in its broadest sense, includes compression from without, strictures, both benign and malignant tumors in the lumen of the intestine, intussusception, and the usual obturation forms, namely, from gall-stones, enteroliths, foreign bodies, and fecal masses.

The nature of the obstruction consists in the simple closure of the lumen of the intestine, either primarily from within, or through compression from without.

Under the special causes of obstruction may be mentioned carcinoma, which is commonly situated in the colon or the rectum, and when found producing ileus appears as a narrow shrinking ring, which macroscopically looks like a cicatrix, and is only to be recognized microscopically as the product of a shrinking carcinoma, or a more or less proliferating nodular mass.

Sarcomas and lymphosarcomas do not, as a rule, even narrow the lumen of the intestine. Schlangé extirpated a spindle-celled

sarcoma, the size of a fist, which arose from the submucosa of the ileum, having a short pedicle.

The tumor had become twisted on its own axis, producing an occlusion.

There are certain processes (tuberculosis, syphilis, etc.) which give rise to ulceration of the mucous membrane, resulting in a cicatrix and causing strictures. Tuberculosis is by far the most common, after which comes syphilis, usually located in the rectum.

Trauma may lead to a contusion of the intestine, producing a local gangrene, and later a stricture. Such cases are mentioned by Noack and Menne. Less frequently they follow dysentery and stercorary ulcers.

Strictures of a severe degree are mentioned by Treves occurring three times in the ileum and once in the jejunum, which had been incarcerated in hernial sacs, the incarcerating ring producing a stricture may follow, and the same may be said of resection formation of a stricture.

After the discharge of the intussusciens in intussusception, a stricture may follow, and the same may be said of resection of the intestine.

Again, in the new-born infant a narrowing can occur at a point where the omphalo-mesenteric duct was inserted, the thick tenacious meconium becoming lodged and producing a stricture.

A most important part is played by adhesions following peritonitis, producing a kinking which may cause an obstruction, or simply favor the lodging of fecal matter there which in time completes the obstruction.

Of the tumors which develop from neighboring organs producing a compression, those arising from the uterus and ovary are by far the most common, yet examples are known of tumors arising from the kidney, spleen, mesentery and pelvic bones which have produced obstruction by compression.

In the strictest sense of the term, the occlusion of the intestinal lumen is produced by free bodies in the lumen, such as gall-stones, enteroliths, foreign bodies and fecal masses.

The gall-stones do not necessarily pass through the common duct, but they frequently pass through fistulæ between the bile-tracts and intestine, and into the duodenum and colon. Occa-

sionally, small stones, after remaining a long time in intestinal diverticula, may grow to enormous size by deposits of phosphate salts, and thus produce obstructions.

As a general rule, stones producing obstructions are larger than a walnut, but very small stones may produce severe disturbances. The prolonged stay of a stone in one place may produce a necrosis and ulceration of the mucous membrane, peritonitis and perforation. The stones may become lodged in any portion of the small intestine, the last and most important obstacle being the ileocæcal valve.

The enteroliths (which are rare) form very gradually in the large intestine, especially in the cæcum. Quite commonly, some foreign body forms the nucleus for their formation. To the enteroliths belong also those masses composed of undigested food,—vegetables, hair, etc.

The foreign bodies which get into the intestine are many and varied, and usually pass without much disturbance. Should they strike a stricture which up to this time had passed unnoticed, they may lodge and produce an acute obstruction. If they are sharp, a perforation of the intestine, with peritonitis, may follow.

In cases suffering from habitual constipation, because of sluggish intestinal innervation, the solid fecal masses may become so large as to obstruct the intestine mechanically.

Obturation ileus is sometimes produced by an intussusception. The ileocæcal valve is by far the most common seat for this lesion. Then follows the small intestine, and, lastly, the colon. The length of the intussusception may vary from a small piece to many feet.

Thus Schlange observed a case of the ileocæcal variety where the valve presented itself beyond the anus.

The invagination of the large intestine usually occurs in the sigmoid.

Of special interest in invagination in general is the condition of the mesentery. Inasmuch as it follows the invaginated portion, it produces traction on the intussusciens and curves it, so that it looks toward the mesenterial insertion. At the same time the invagination turns, thus approaching the spine. The longer the invagination, the more characteristic this will be.

Circulatory disturbances usually follow in the invaginated

mesentery, depending upon the length of time and the extent of the invagination.

A more or less severe hyperemia develops in the intussusciens and its mesentery, followed by œdema.

If the stasis continues, hæmorrhage into the tissues and the lumen of the gut will follow. Where the obstruction is only partial, and the circulation not completely interrupted, leaving the lumen of the gut partially open, a chronic course will follow.

Where the circulation is completely interrupted, the course will be acute, followed by gangrene of the intussusciens, which may be cast off. These pieces vary in length from a few centimetres to three metres. Thus, Lichtenstern found that the separation occurred in the majority of cases during the first month, but several times only after six months or even later.

The acute dangers of this disease lie in perforation of the intestine at the neck of the invagination, and secondary peritonitis.

In the chronic forms emaciation threatens the life of the patient. Even though the intussusciens has been cast off, a stricture may follow which can interfere with the recovery of the patient.

Symptoms; Acute Forms.—Whenever the lumen of the gut is completely obstructed by some foreign body, the onset is sudden and consists of acute pain in abdomen, distention, increased peristalsis, nausea and vomiting (possibly becoming fecal), and possible absence of bowel movements. From constant pressure of such a body on the intestinal wall, perforation and secondary peritonitis may follow.

In acute intussusception with complete obstruction, the symptoms are similar, excepting that here, when bowel movements occur, bloody mucus will be found. So long as there is no general peritonitis, the upper part of the intestine will be distended, and the lower portion collapsed. Peristalsis will be present in varying degrees of intensity, being especially severe in the chronic types because of the gradual hypertrophy of the musculature from use.

More commonly in obturation ileus the onset is not sudden, because the obstruction is not complete, because if it is due to a foreign body, it may be constantly moving. Should there be a stricture or adhesions of which the patient may be entirely una-

ware, a foreign body or fecal mass may lodge and cause a sudden occlusion of the gut.

In the more chronic type, this entire group may be observed, but they are slow in developing.

Diagnosis.—There are certain peculiarities of this disease to which there are many exceptions. First, absence of intense initial and continued pain. Second, absence of symptoms of collapse. The representative cases are those which come on gradually, as in chronic intestinal narrowing, which ultimately leads to complete occlusion. The general diagnosis of ileus is, as a rule, not difficult, but the special diagnosis may be not only difficult but impossible.

In many instances, a careful history will not only give us a clew, but make the diagnosis of the cause of the obstruction. Thus, a history of having swallowed a foreign body or of having had a non-absorbable foreign body introduced during a resection of the intestine, or a history of a former abdominal injury which might lead to adhesions or stricture, favoring a sudden lodgment of foreign or fecal matter.

Previous history of gall-stones might give us a clew suggesting the lodgment of a gall-stone in the intestine. The slow onset, and steadily increasing symptoms, might suggest the presence of tubercular or syphilitic strictures or tumors.

His own experience in attempting to diagnose the *cause* of an ileus has been more or less of a failure, for ample reasons. In the first place, it constantly happens that a beginning peritonitis clouds the diagnosis so successfully that it is almost impossible, especially with the frequent poor histories obtainable, to distinguish between a paralytic and a mechanical ileus, and as to making a special diagnosis, there are so many possibilities of internal strangulation alone, from which obturation ileus must be distinguished, that it can rarely be done excepting with the aid of a good history.

Errors in diagnosis are not at all uncommon. Thus, in the case of a man at the Cook County Hospital who could give no history whatever because of his inability to either talk or understand the English language. On examination, his temperature was 101° , pulse 100; abdomen tender; some tympany; a little free fluid was present; vomiting frequently; no peristalsis. He

had an irreducible left-sided inguinal hernia, which was about the size of an adult fist, and very tender to the touch. He had worked until the day before his entrance to the hospital. He was not emaciated; no signs of cachexia.

The speaker operated on his hernia, and found that it was not a strangulation, but merely an incarceration. During the operation, considerable fluid ran from the abdominal cavity, which had a very distinct coffee odor. The hernia was repaired and a drain inserted. The abdomen opened in median line above umbilicus, and a small carcinoma, which had perforated, situated on the anterior wall of stomach, was found. The opening was plugged with a piece of omentum, and the abdominal wound closed, with drain. The patient died the following day.

In another case the diagnosis of a left-sided diaphragmatic hernia was made. The patient's temperature was 97° ; he was in a partial stage of collapse; extremely anxious and pale; pulse was 140; excruciating pain in left diaphragmatic region. Nausea and vomiting. After examination, all the findings of such a hernia were absent; no operation was undertaken, because it seemed as though the patient might have the beginning of some other disease, which proved to be the case the next morning. He had all the findings of a pericarditis, and after a variable course recovered.

Treatment.—In obturation ileus, enterotomy is of especial value, in relieving the intestine of its poisonous contents, and because of the simplicity of the operation. A radical operation may follow at some future time, when the patient may be in better condition.

In strangulation ileus, it is necessary to relieve the strangulated intestine, and save it from gangrene, or to resect the gangrenous portion. In general, it may be said that the cases of ileus come into the hands of the surgeons much too late. Many general practitioners wait for fecal vomiting before they transfer the case.

THE ABUSE OF CATHARTICS IN OBSTRUCTION OF THE BOWELS.

DR. M. L. HARRIS said that it is one of the rarest things in the world for a surgeon to be called in to operate on a case of ileus that has not run the gauntlet of the whole list of cathartics,

in the vain hope that one would at last be found which would stay down long enough to in some magic way loosen the Gordian Knot and bring about a bowel movement, so that even though the patient die as a result he will at least have died cured.

The reasons why physicians so frequently err in this regard are chiefly two, namely imperfect knowledge of the pathology of these cases, and incorrect diagnosis.

The physician is called to see a patient who has a pain in the abdomen with nausea or perhaps vomiting, slight distention, some tenderness and no bowel movement. An inquiry is immediately made as to what has been eaten. This is found to have been some sausage, or pancakes, or something else which had been eaten a hundred times before without inconvenience, but now it is looked upon as the offending agent and a physic is prescribed to carry it off. No result following, other and more powerful physics are brought into service as the vomiting of the patient and the frenzy of the physician to secure a bowel movement increase, until it finally dawns upon the doctor that the trouble is not that the bowels do not move, but the bowels do not move because there is some trouble.

The speaker recently saw a patient suffering from a strangulated inguinal hernia, with an enormous abdomen and vomiting every few minutes, who was still trying to get his physic down between vomits, and another with acute appendicitis where the attendant wondered why no result followed the cathartics, in which an operation disclosed a very large opening in the cæcum left by the sloughing off of the appendix and through which the intestinal contents chased by the cathartics had escaped into the abdominal cavity.

Numerous other cases illustrating all the varieties of intestinal obstruction could be mentioned did time permit, but the purpose here is merely to call attention to the harm which results from the administration of cathartics in these cases.

In all varieties of strangulation obstruction in which are included all varieties of herniæ, external and internal; strangulation by bands; adhesions; kinking; volvulus; intussusception, etc., it will be perfectly apparent to every one that cathartics cannot possibly do any good, but are always productive of harm. Yet one scarcely ever sees a case belonging to this class that has

not been dosed repeatedly with cathartics, much to the detriment of the patient, before a diagnosis has been made, sometimes even after.

In dynamic obstruction whether of the paralytic or spastic variety, it is practically impossible to force anything along the affected portion of the bowel so long as the condition persists.

Whenever a portion of the bowel is paralytic and distended or spastically contracted, the intrainstestinal current is almost as effectually blocked as it is when a loop of bowel is strangulated in a hernial ring. There is this great difference however. The paralytic or the spastic bowel may and usually does recover under appropriate treatment, while the strangulated bowel is rapidly and surely advancing to certain death unless it be relieved by an operation.

The acute inflammatory affections, such as appendicitis, cholecystitis, pancreatitis, salpingitis, sigmoiditis, etc., which begin as more or less circumscribed conditions, form a very important class in this connection.

In many of these cases bowel movements are temporarily but completely suspended owing to the fact that the loops of bowel adjacent to, and involved in, the inflammatory process are paralyzed, and at times fixed by the first plastic exudate which is thrown out. The purpose of all this is a conservative one, namely, to circumscribe the focus of infection.

The exhibition of cathartics under these circumstances can produce only a harmful effect by breaking down the protecting plastic wall and extending or disseminating the infectious material.

Whenever the bowels are incapable of acting by reason of any of the obstructing causes above mentioned, cathartics, by stimulating in vain the peristalsis of, and increasing the amount of fluid in, the proximal portion of the bowel, favor intestinal putrefaction with absorption of toxic products; cause a reverse flow of foul offensive fluid into the stomach with the production of exhausting vomiting; so damage the bowel immediately cephalad of the obstruction as to favor the migration of microbes into and through its walls; increase an intussusception; hasten the cutting through of a constricting band or ring; aid in the extension of paralysis; facilitate the dissemination of infection,

and in fact, do infinitely more harm in less time than could possibly have resulted from the primary trouble had it been left undisturbed. These facts, which rest on sound reasoning, accurate pathology and clinical experience, cannot be too strongly emphasized.

Cathartics should never be given to a patient suffering of an acute abdominal trouble until a diagnosis has been made, or if not an accurate diagnosis, at least until all of the conditions mentioned which may produce obstruction, have been positively excluded, and let it always be remembered that these patients are never sick because the bowels do not move, but the bowels do not move because they are sick.

CORRESPONDENCE.

OVERLAPPING APONEUROSIS IN SUTURE OF ABDOMINAL WOUNDS.

TO THE EDITOR OF THE ANNALS OF SURGERY:

In the ANNALS OF SURGERY for the month of March of the current year two articles have been contributed—one by Mr. Noble and another by Mr. Flint. In both articles the authors have shown that they are unfamiliar with the results of Russian investigation respecting the question. Mr. Noble (“Overlapping of the abdominal wall—including umbilical, ventral, and inguinal herniæ”) recommends the overlapping of the aponeurosis of one edge of the wound on the aponeurosis of the other edge of the wound, in the closures of wounds of the abdominal wall, and quotes some authors who applied the same kind of stitch before him or contemporaneously. Mr. Noble does not, however, say anything at all about such a method of sewing up abdominal wounds having been recommended as early as the year 1900 by Professor Sapiejhko, who has described it in Russian publications (*Annals of Russian Surgery*, 1900) as well as in foreign ones (*Revue de Chirurgie*, *Centralbl. für Chirurgie*, etc.). No mention is made of the fact that a similar process was made use of by me even in 1898, which has also been described in Russian (Report of the Surg. Klinik of the Twerskaja Association of Sisters of Mercy of from 15th October, 1896, to 31st December, 1898, Moscow, 1899, page 150. *The Surgery*, 1899, vol. V, p. 471. Lectures on oper. surgery by Prof. P. T. Diakonow, Prof. F. A. Rein, Prof. N. K. Lysenkow, priv-doc. N. T. Napalkow, p. 112) and in other languages (*Die medicinische Woche.*, 1900, 2d April).

As regards the other paper, by Mr. Flint (“A New Method of Excision of the Knee Without Opening the Joint”), it can be said that that method, spoken of by the author as “new,”

is in reality very old; it was applied (see Falkenberg's work) by Manne in 1879, by Mulder in 1809, and in 1871 by Wladim-irow. It has afterwards been again tried by a whole series of Russian surgeons (Wolkowitch, Sapiejhko, Sabanejew, Falkenberg). The results of their operations have been described in *The Physician*, 1896, and cited in the *Centralblatt für Chirurgie*.

Your very truly,

P. T. DIAKONOW, M.D.,

Ord. Prof.

Moscow, RUSSIA, May 6, 1906.

All contributions for publication, books for review, and exchanges should be sent to the Editorial Office, 386 Grand Ave., Brooklyn, New York.

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ORIGINAL MEMOIRS.

ON THE USE OF THE MASLAND SAW FOR OPENING THE CRANIAL VAULT.¹

BY H. C. MASLAND, M.D.,

OF PHILADELPHIA.

ABOUT one year ago when we first presented before The County Medical Society a new cranial saw, utilizing the power-driven circular saw principle, we felt that the ideas involved and the practical applicability were assured.

Since then we have studied carefully the details of construction so as to produce an instrument thoroughly reliable under all circumstances. The only change made in the saw itself has been to increase the diameter of the circular saw, thereby insuring ability to cut through the thickest skull that might be encountered.

The motor is a sixth horse-power, which has been demonstrated strong enough to drive the saw with perfect ease through the hardest bone.

The flexible cable has been made stronger. It is strong enough to stop the motor without injury to the physical condition of either motor or cable.

It will be seen that a motor ample for any demand of power required, and a cable strong enough to drive the saw with certainty and steadiness through the hardest bone,

¹Read before the Philadelphia Academy of Surgery, April 2, 1906.

and yet stronger than the motor itself, secures a reliability of mechanism above every requirement.

The saw is so simple in construction that it can hardly get out of order. The chief necessity is to see that the bearing of the saw shaft is lubricated with a sterile oil. This is done by dropping, as needed, oil in the oil-hole provided at the side of the bearing.

It is appreciated that this instrument opens the skull with a smaller waste of bone-tissue than any other instrument yet devised. The width of section, but one millimeter, and the bevelled cut, permits the replacement of the bone flap on a firm shelf with insignificant sinking of the flap; securing, in other words, a postoperative condition as substantial as before the skull was cut.

We have demonstrated that the skull can be entered with this instrument by either of two methods of operation, each of which has certain advantages which will recommend the one or the other to different operators. The plan of operation depends upon whether one prefers the inside or the outside guard.

In my former paper, I advocated the use of the outside guard. This method does not require the making of any preliminary openings. The osteoplastic flap is, preferably, four-sided, with the shortest side at the basal portion of the skull. This side is to be left uncut for the retention of the vitality of the flap. With a scalpel the flap is outlined in the soft tissue and the tissue cut to the bone surface.

Leaving the flap adherent to its underlying bone, the tissue on the outer side of the incision is dissected away to allow the easy access of the saw. The guard is then set for a depth that we are reasonably sure will not penetrate the thickness of the skull. The saw is always held with the cable side overhanging the flap. This permits a better observation of the section and makes more easy the bevelling of the incision through the bone. After the first cut, the incision is percussed with a bone-sounder which I have devised for the purpose (Fig. 3). A trained ear can learn

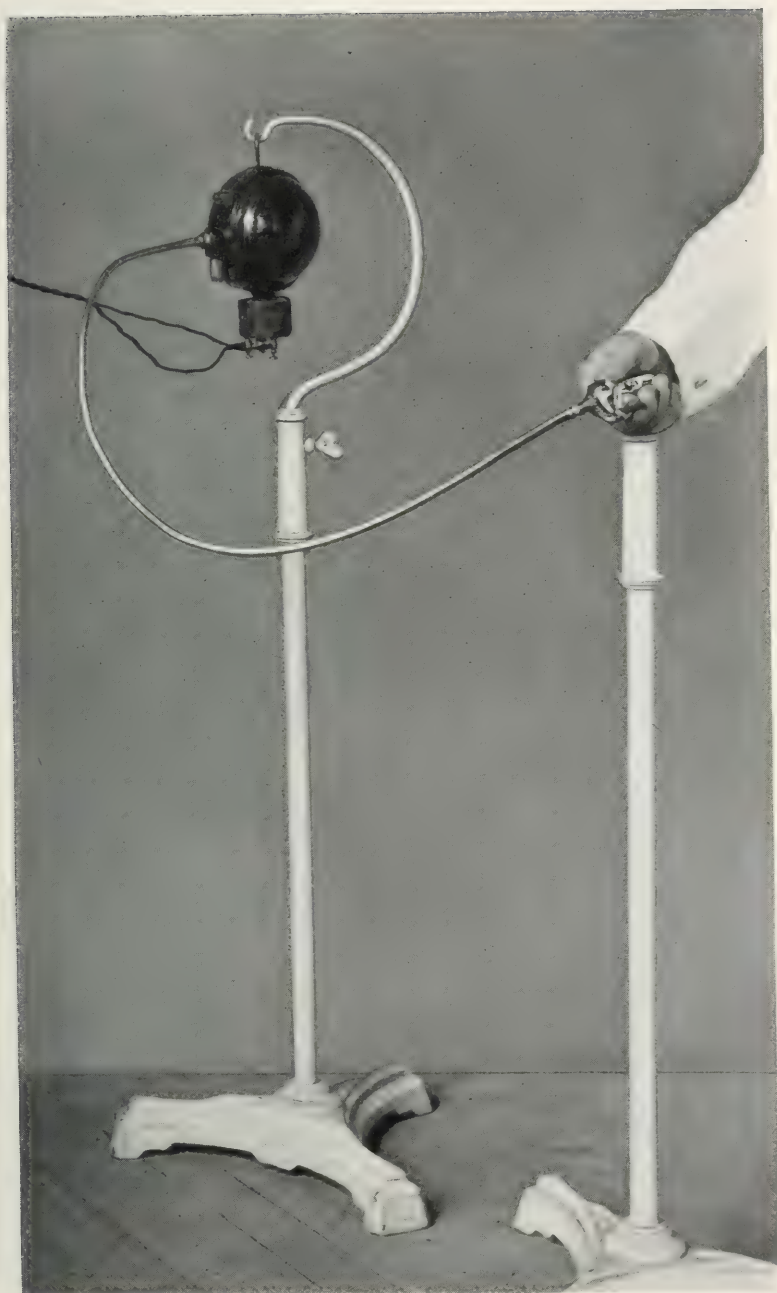
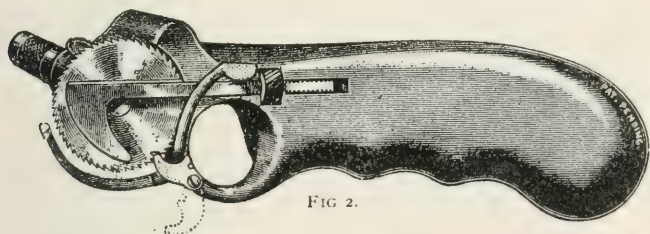


FIG. 1.

from this the relative thickness of the uncut bone. According to one's judgment the guard can then be set coarse or fine. It is possible to set the guard for a difference of one one-hundredth of an inch. Naturally the skill of the operator is called in play in making the final incision through the skull to protect the dura. Only the exercise of undue haste would result in injury to the brain-tissue. After completing the bone sections, soft-tempered steel chisels are inserted in the cut bone at opposite sides of the flap. Springing the flap up with these chisels the remaining short side is broken and the vitality of the flap thus preserved.

It will be seen that the chief problem involved in the use of this saw is to make the section without injury to the



subjacent dura. The saw, rotating 1500 or 2000 revolutions per minute, cuts the bone with practically no pressure on the part of the operator. As to the mere cutting of the bone the question of time is eliminated. The greatest care, however, should be exercised in the final stages of the section. It is true that the tactile sense with this instrument is preserved, and surgeons have expressed the opinion that they could tell when they have entered the skull cavity without the use of the guard. I would advise, however, the taking the time with finely-graded adjustments of the guard to prevent injury to a dura intimately attached to the bone.

In my judgment the chief necessity for this care is to obviate hæmorrhage by cutting a dural vessel. True it is preferable to cut the dura subsequently inside the line of the bone incision to facilitate suturing, but the only ill effect arising from simple cutting of the dura by the saw would be the more troublesome subsequent suturing. Hernia cerebri considering the perfect bony support, is impossible.



FIG. 4.

It is evident that this instrument, notwithstanding its ability to make a flap superior to all others, must still be able to cut the bone with as little or less injury to the sublying tissues than the best of the others, to entitle it to recognition as being distinctly superior.

The method just described will accomplish this better than any other instrument yet devised with the exception of the Cryer drill. I believe however that with the use of

the inside guard on my saw, the dura can be protected from injury with absolute certainty. Using this method the outside guard is discarded. The skin section is made as before mentioned. At the two superior angles of the flap, preliminary openings are made about $\frac{3}{16}$ of an inch in diameter, the guard, detached, is then entered in the opening and the dura pressed away from the inner table of the skull. The saw is now used to cut two grooves in the bone chiefly to the outer side of the opening and almost through the bone. (Fig. 4.) These cuts are made in the lines of the intended bone sections. They permit the entry of the guard in a more oblique manner. The shaft of the guard, now attached to the saw, occupies this groove and is supported by its sides. The idea of this groove is to give the saw more room so that it may cut the more easily the bone at the side of the opening. The guard is now kept by the pressure of the thumb on the handle arm in constant contact with the inner wall of the skull, and the incision is advanced. It will be noticed that the guard, to prevent its own destruction, does not come in immediate contact with the teeth of the saw. As a result of this, a thin section of the bone on the inner table of the skull may remain uncut. So soon as the handle-arm of the guard presses upward this condition is in all likelihood present. The advance of the saw is immediately checked, then by pressing the handle of the saw downward, practically rotating it downward with the guard-tip as the pivotal point, the guard sinks deeper and presses the dura away, the saw also sinks deeper and cuts through this remaining portion. The further progress of the incision is then pursued. Starting on a new line of incision the guard is adjusted in the opening and this side of the flap cut as before.

It is always to be borne in mind that when the handle-arm of the guard rises up against the thumb, the advance of the incision should be checked, and the reason for this movement of the guard ascertained. If we find that the bone has been cut through, then it may be an internal ridge

of bone or an adherent dura giving the trouble. Should it be a ridge the only care is to have the guard advance over and past it without deflecting into the deeper tissues. This should give no special trouble. It may be that the dura resists the detachment by the guard. Should this occur it is better to detach the guard from the saw, and using it as a blunt dissector coax the dura away from the bone as far as the guard can be advanced. The saw is then attached and this portion of the bone divided. This process can be repeated as often as necessary. The essence of careful surgery would recommend this as the absolute method of preventing injury to the underlying tissues.

I am confident that the plan of operation I have outlined, which takes longer to tell than to perform, removes with certainty the liability of injuring the dura or producing serious hæmorrhage. The bleeding that would ensue would be the usual bone bleeding that is expected.

The subsequent breaking of the undivided side of the bone-flap is performed as before, and is familiar to all.

In claiming for this instrument a superiority as to method and results over all other instruments used for the purpose, it may be well to mention some of the chief disadvantages of these instruments and show wherein this new one excels.

The hand trephine, descended to us from remote antiquity, requires but little notice. Its tendency with the best of care to injure the dura or even the brain-tissue is known to all. It destroys the vitality of the button of bone, and makes an opening restricted to the fixed diameter of the trephine in hand. It is tiresome, dirty and practically abandoned by the advanced cranial surgeons.

The Stalwagen trephine is a considerable improvement, but it is still possessed of many of the defects of the original trephine. It is very tiring to the hand and is easily capable of injuring the dura and causing serious hæmorrhage. It does not permit of a bevel edge and the sustaining shelf so desirable. There is a tendency to jam consequent upon and

inseparable from its mechanical construction. This jamming is intensified as the cut becomes deeper. Subsequent enlargement of the original opening must be made with the bone forceps, with a resultant waste of bone.

The mallet and chisel are probably used by more of the best surgeons to-day than any other instruments. Yet after all such weapons are a shock to us, more to the laity and most to the unfortunate victim requiring its use. The charge has some merit that more perfect instruments should have been devised long ago. Yet we are aware that the mallet and chisel have many elements of superiority. They permit of sections of any desired shape and size, and they permit of reposition of the bone-flap upon supporting spicules of the surrounding bone, giving results possibly attained by no other instrument heretofore used. The objections to the chisel are the length of time required to make the bone-flap, the concussion that undoubtedly does add to the risks of the patient, and the great likelihood of the bone suddenly giving away and the skull contents being injured. The difficulties of the mallet and chisel increase many fold with an unusually thick or hard skull. While a surgeon with much practice may become high-master in the use of the mallet and chisel, yet all appreciate that its use generally is fraught with many perils.

The foregoing instruments have the advantage of cheapness and that they are dependent upon no mechanism restricting the wide range of their usefulness.

The Cryer instrument, devised by Dr. Cryer of this city, is a departure from the principles of its predecessors. It receives its cutting power from a mechanical source external to the operator. A side-cutting drill is used to make the section in the bone, and an inside guard is provided that protects the dura from all possible injury. The flap section is made large or small at the will of the operator. Celerity is attained, hæmorrhage is avoided, and a vital flap is secured. Some of its disadvantages are that it makes a wide incision of the bone, not permitting the shelf support so

desirable. The drill is necessarily slender, to make a reasonably narrow incision. Inasmuch as the force is applied against the long diameter of the drill, the point of least resistance, the drill must not be pressed too hard against the bone or it will break.

The inside guard prevents the instrument being withdrawn till it is carried back to the original opening. This may present a very considerable disadvantage under certain circumstances. The operator's hand must constantly occupy a constrained position in keeping the guard up against the inner wall of the skull.

An instrument devised by Alfred Sykes, of Yorkshire, is a modification of the Cryer instrument having a handle at right angles to the drill-shaft. This instrument, of which I have seen the illustration only, possibly relieves this uncomfortable position of the hand, though I would not judge it as useful as the Cryer instrument in other respects.

While the Cryer instrument can be sterilized, its structural parts cannot be dissociated by an amateur for thorough cleansing purposes.

The Doyen saw utilizes the circular saw but without an efficient guard to adequately control the depth of cut. Its construction does not permit that steadiness and fine control which is an essential in this class of instruments. I am informed by Prof. Keen that as he saw it used it was no more rapid than he found possible with his mallet and chisel.

The Doyen small saw is a Hey saw with the addition of an adjustable guard. It is subject still to practically all the disadvantages of the Hey Saw.

In the Sudeck instrument the circular saw is placed between the handles. The instrument is grasped as a woman would grasp the handles of a rolling-pin. It does not have an adjustable guard. While by no means devoid of merit, yet its construction prevents the utilization of many of the principles which are necessary to make a thoroughly practical saw. The defects of the foregoing instruments are apparently overcome by my new saw.

The osteoplastic flap can be made any size or shape.

The time required to make the cut is as short as can possibly be hoped for.

When using the outside guard, it is impossible to cut deeper than the depth set by the guard.

The likelihood of hæmorrhage, particularly with the use of the inside guard, is obviated.

The incision is but one millimeter in width, whatever the thickness of the skull.

Perfect bony support for the reposed flap is secured to a degree not heretofore obtained, giving perfect bone protection to the brain.

The instrument gives no vibration, a thoroughly comfortable grasp to the hand, and occasions no tension of the hand, permitting a full utilization of the sense of touch.

The inside guard, when used, can be detached immediately and the saw at once withdrawn from the cut.

The saw is so simply constructed that by observing a few simple rules no mishap in its working should occur. Further the construction is so simple that a nurse or a amateur can take it apart and cleanse it thoroughly, replacing the parts without trouble.

It will no doubt take time for the profession to accustom itself to this new instrument, but I firmly believe that a utilization of the principles here involved will open up a new field in successful and more perfect surgery of the brain.

ON THE USE OF THE TEMPORAL FASCIA TO COVER IN CRANIAL DEFECTS.*

BY CARL BECK, M.D.,

OF NEW YORK,

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AMONG the manifold methods in use for covering over defects of the cranium, the osteoplastic, employing a living bone-flap, as advised by Mueller and Koenig, is the one most commonly selected. Only in cases where the execution meets such technical difficulties as insufficiency of diploe or excessive thinness of the surrounding material, would one fall back upon one of the various heteroplastic procedures. In these subsequent remarks may it be permitted me to point to another possible method of bridging over the defect. This is not a technical improvement over those most excellent methods already mentioned, but at the same time it meets an indication in lacerated wounds which they do not, viz., the question of adhesions after cicatrization. And indeed this point is of decisive import. Jackson, as is well known, noticed that cerebral epilepsy can be caused by minor tissue changes, especially scars. The recognition of this etiological fact nurtured the thought of removing parts of the scar, or similar changes. Several operators have actually been successful in achieving results in this hitherto unfertile field.

The report of Graf¹ comprises 92 cases of Jacksonian epilepsy, in 82 of which tissue changes had taken place. These involved either the brain, the membranes of the

* Read before the German Medical Society of New York, April 30, 1906, with presentation of patient.

¹ Operative Behandlung der Epilepsie, Arbeiten aus der chirurgischen Klinik der K. Universitaet, Berlin, 1898, Thl. 13.

brain, or the skull itself. Seventy-one cases in all were operated upon; 4 died, 20 remained unimproved, but 22 were completely cured. Furthermore it appears that 23 cases which had been observed for too short a time to justify a final verdict became well. For it is often the case that the attacks vanish for a space of time, due perhaps to transient traumatic irritations, and then recur later on with renewed or aggravated violence.

The best surety for permanent cure seems to me to prevent firm reunion after extirpation of the cicatrix. The apposition of periosteum and brain must necessarily cause more or less unyielding scars. A plastic transposition of the dura can only be thought of in small defects. Therefore I sought a material which shows no marked tendency toward adhesion, and believe I have found it in the strong fibrous sheath presented by the temporal fascia. We know that in operations upon aponeuroses, union takes place with the surrounding structures through loose, wide-meshed, web-like connective tissue. When we fold over the flap gained from the temporal muscle and periosteum, then the brain is covered by fascia, the periosteum remaining on top. Slowly a protecting lid is formed which gives ample protection even though it does not attain the thickness of a bone-flap. In this wise the question of cover and adhesion is considered at one and the same time. In the following case the theoretical reflection has been borne out in practice.

The patient, 41 years old, had been well until he fell from a height of 20 feet on May 6, 1904. He landed on stony ground and in an unconscious state was carried off to a hospital where he lay in a comatose condition for eleven days.

As far as I can find out, the diagnosis of fracture of the skull had been made, and several bone-splinters had been removed on the day of the injury. Twelve days later the wound had healed and the patient was allowed to go home. He was treated there by his family physician Dr. W. A. Goodall, from whose report I gather that the right arm and leg showed slight signs of paralysis during the first three weeks after his discharge

from the hospital. These gradually grew better until, six weeks after the injury, epileptic attacks set in. These came on without the usual aura. Patient suddenly became unconscious, the fingers, arms, and then the legs began to tremble. Gradually relaxation set in and patient slowly awoke from his senseless state. During these attacks, which lasted from three minutes to three hours, the pupils failed to react. There was also a marked psychical change in patient. Memory had grown weaker; formerly good-natured, he became morose and easily irritated. Patient's wife declares that his intelligence has suffered. There seems to have been no injury to the substance of the brain. Alcohol is no longer well borne, as the use of same causes congestion.

In September, 1905, I had the first opportunity of seeing the patient. At the time I found an elliptical defect, about three inches long and one inch wide at its greatest diameter, which reached from the summit of the left frontal bone to the temporal. Compare with skiagraph Fig. 4, which shows the shape of defect slightly enlarged. The gap was very large and showed distinct pulsation. No bone substance could be found in the groove.

It appears as though the skin had grown directly onto the cerebrum. A skiagraph, taken a short while later, confirmed the total absence of bone-substance.

In order to create a protection for the gap and also to prevent the formation of adhesions, I proposed an osteoplastic operation to the patient. He consented very much later after having undertaken numerous consultatory travels. Three months ago he entered the Post-Graduate Hospital where Prof. Hammond was kind enough to subject him to a neurological examination. He agreed with me in the belief that we had to deal with a case of Jacksonian epilepsy. Operation seemed especially indicated as the attacks had lately become not only more violent, but the disturbances in the function of the senses had also progressed.

On February 8th I laid bare the defect with an incision which passed around the gap in a wide circle. Slowly working my way along from the side I divided the scar tissue, holding the cutting edge of the knife toward the skin so as not to injure the brain. Then I found that the dura had remained intact



FIG. 1.—Flap of temporal fascia being raised adjacent to cranial defect.



FIG. 2.—Flap of temporal fascia reflected so as to cover brain surface exposed by cranial defect.



FIG. 3.—Showing appearance of patient three months after plastic operation to close cranial defect.



FIG. 4.—Showing bone proliferation in the lower two-thirds of the defect three months after plastic operation.

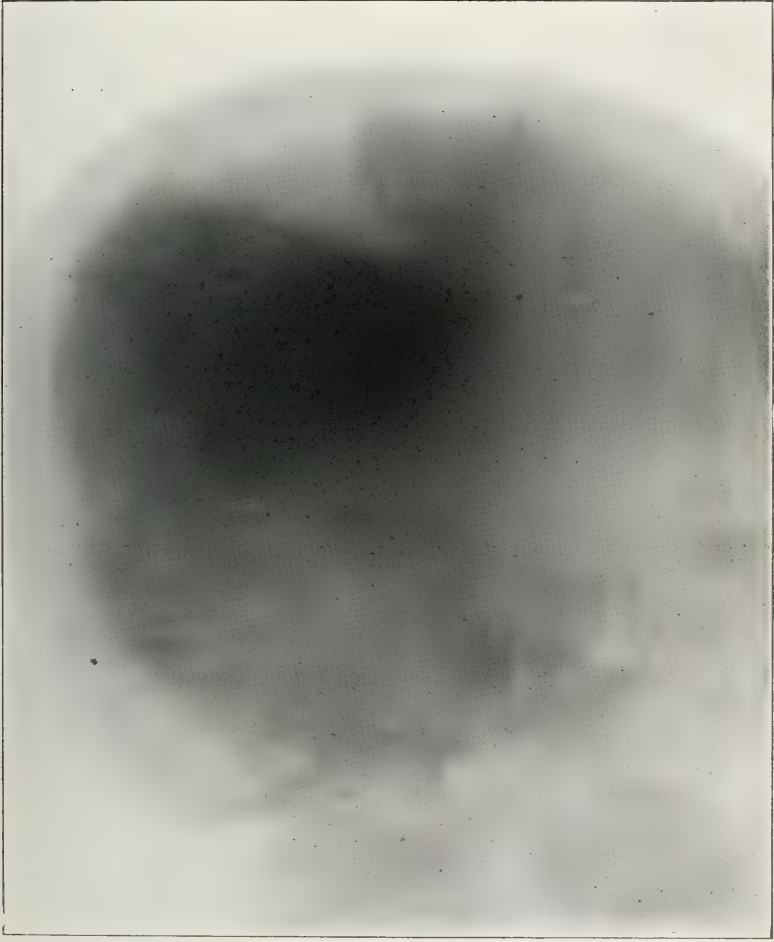


FIG. 5.

only along the edge of the defect. As the skiagraph had shown, small stalactite-like projections had formed at different spots along the edge. These were removed by scissors and bone-shears. During this manipulation a small cyst which had formed under one of these protrusions was emptied of its greenish-yellow contents.

Now, if, as apparent, the pressure-symptoms were principally the result of the extensive scar-formation, then it was necessary to employ a method in covering the defect, which excluded such dense adhesions as had formed. As already mentioned I believed the needed material would be found in the temporal fascia. I commenced the procedure by carrying an incision around the muscle down to the bone. Then I loosened the flap with the periosteum, taking great care not to tear the connecting link of periosteum which was kept as close to the bone suture as possible. (Fig. 1.) Although the periosteum was firmly adherent there it was but loosely attached to the rest of the bone and might easily have been torn off, a condition which might have ruined the whole procedure.

I folded over the entire flap at the lower edge of the defect and covered the gap with it. At the opposite end I chiselled off enough bone to enable me to make use of a small amount of dura to which I attached the aponeurotic end with thin cat-gut sutures. (Fig. 2.) The aponeurosis then lies in direct contact with the brain, with the periosteum on top. The skin surfaces were united. The wound healed primarily. The general health of the patient has improved and he feels normal in every way. Up to date he has had no convulsion.

I am well aware of the fact that the period of observation has been too short to make a pass verdict concerning the convulsions, and I will report concerning them again later on.

As far as the plastic operation is concerned, a decided success has been gained. Although the operation enlarged the defect somewhat by the removal of bone, the defect at present shows a smaller gap than before (Fig. 3). The latter is not as large as before operation. If we palpate the groove we can plainly demonstrate the bone which has formed from the periosteum. The same is visible on the

skiagraph (Fig. 4) as a faint cloud. Of course the lid is not as solid as a bone-flap would make it. But is this absolutely a necessity, and does not this light covering perhaps render the same service? The utilization of aponeuroses in the place of muscle-tissue might also prove of value in such cases in which we desire to prevent reunion by insertion between bone fragments (as ankylosis, etc.).

Since making this report I have had another opportunity of performing the same operation on a boy of thirteen years, who fell out of a window a year ago and sustained a compound fracture of the skull. I am informed that he vomited considerably during the first twenty-four hours, was paralyzed, but able to talk. Ever since he showed symptoms of Jacksonian epilepsy. May 13, I exposed the defect the size of which exceeded somewhat that of a silver dollar, at the St. Mark's Hospital. There were dense adhesions between skin, dura and arachnoid, which were divided. The defect was situated on the left parietal bone. As it extended nearly up to the top of the skull, it required a long flap to reach it. There was no reaction after the operation, the patient being well at the present writing (two weeks after the operation).

ACUTE SEPTIC INFECTION OF THE THROAT AND NECK; LUDWIG'S ANGINA.

BY GWILYM G. DAVIS,
OF PHILADELPHIA.

THE acute septic infection which involves the mouth, throat, neck, submandibular and parotid regions, known clinically as Ludwig's angina, is as yet not thoroughly understood as regards its pathology, nor is its treatment efficient. It is an extremely fatal disease, and in many instances probably unnecessarily so. The modern exact methods of observation, record and research should be applied to it, so that the affection can be recognized and its treatment placed on a proper scientific basis. Septic inflammations of the neck were more or less well known before 1836, but in February of that year D. Ludwig, of Stuttgart,¹ described what has since been known as Ludwig's angina. He stated that it was fatal in almost all cases. It began with slight fever, chills, headache, disturbed appetite, coated tongue, and often difficulty in swallowing. Usually on one side of the neck affecting the cellular tissue in the region of the submaxillary gland, rarely the sublingual or parotid, a hard swelling appeared. It spreads under the chin around the neck to the opposite side, over the larynx and perhaps the parotid. The sublingual region is infiltrated and the tongue rests on a hard base. It is both painful and difficult to open the mouth. Speech is impaired and partly from pressure on the larynx and partly on account of involvement of the smaller neck muscles the voice is rough and guttural. Mucus, which is difficult to expectorate, accumulates in the throat.

Early in the disease, during the first four or six days, the skin is not red and the constitution not much affected. Later openings occur posteriorly on the inside of the mouth, and a thin gray or red brown evil-smelling liquid exudes.

A gangrenous odor develops, the lungs become affected and death ensues in ten or twelve days. On post-mortem examination the cellular tissue and muscles around and under the jaw and the posterior portion of the throat are found to be gangrenous.

This description of Ludwig is typical of the severer forms of the affection, and it was henceforward known as Ludwig's angina.

In 1895, however, Felix Semon² of St. Thomas' Hospital, London, in a paper before the Medico-Chirurgical Society, claimed that the various affections hitherto described as acute œdema of the larynx, œdematous laryngitis, erysipelas of the pharynx and larynx, phlegmon of the pharynx and larynx and angina ludovici were simply various forms of acute septic inflammation of the throat and neck and pathologically identical; also that they merely represented degrees varying in virulence of one and the same process, and that the question of their primary location and subsequent development depends in all probability upon accidental breaches of the protecting surface through which the pathogenic micro-organism finds entrance; and that it is absolutely impossible to draw at any point a definite line of demarcation between the purely local and the more complicated, or between the œdematous and the suppurative forms. His views have been more or less accepted by probably the greater number of writers on the subject.

Before a disease can be said to be mastered we must understand its pathology and therefrom deduce a rational method of treatment. Any method of treatment not based on the pathology of an affection must be more or less empirical and therefore to a considerable extent unreliable and uncertain. For this reason a knowledge of the pathology of a disease is the first step toward efficient treatment. Ludwig recognized that the disease was one of septic infection, but in his day, 1836, bacteriology was practically unknown, and he was limited in his knowledge to clinical observation and gross post-mortem examination. We

should know (1) what is the germ or germs that start the infection; (2) how do they gain access to the tissues; (3) what tissues are attacked; (4) how the infection progresses; (5) how it influences the parts locally and, finally, (6) how it affects the system generally. Our knowledge is so incomplete that partial answers only can be given to these questions.

1. What is the germ or germs that start the infection?

Inflammations of the throat can be produced by mechanical and chemical irritants, as by injuries and poisons and œdema occurs in Bright's disease, but these are not due to infection and as a rule do not resemble the latter either in their clinical appearance or course. As regards the character of the infection we are still considerably in the dark. In almost all cases germs are readily detected, but their exact nature and action are to a great extent unknown. In some cases pure cultures of a single micro-organism are found while in others so many are present that it has been found to be impossible to identify them. Even when only one or two kinds are found it is not proof that others were not present likewise. Mixed infections are common. If crepitation is present in the tissues it is assumed that a gas-producing bacillus is its cause, and while it may be found it will probably be accompanied by other organisms. Fetor is likewise attributed to a bacillus, but this is not so certain as in the case of gas. Fetor is a common accompaniment of severe cases, yet the presence of bacilli is comparatively rarely recorded. Another disturbing element is the known fact that certain organisms act very differently, according to the tissues in which they develop. The pneumococcus in the lung may produce a lobar pneumonia which is quite different from the infectious conditions of the neck in which it may be the only demonstrable organism. The streptococcus of cutaneous erysipelas seems to act in an entirely different manner from the same organism in the deep tissues of the neck.

In twelve cases in which the character of the infection

is noted the following organisms were found: Case 1, streptococcus; 2, staphylococcus and pneumococcus in the mouth and streptococcus in the pus; 3, pure streptococcus; 4, Eberth's bacillus in the spleen and pure streptococcus in the tissues; 5, pneumococcus and some streptococcus; 6, streptococcus; 7, staphylococcus albus and aureus; 8, pneumococcus; 9, streptococcus; 10, large bacillus and staphylococcus aureus and pyogenes; 11, some bacilli, diplococci and streptococci; 12, staphylococci, streptococci and some non-identified organisms.

We thus see that in Cases 1, 2, 3, 4, 6 and 9 streptococcus in the pus and tissues was the sole organism detected. In Case 8, pneumococcus alone was found. In Case 7, staphylococcus alone was found. So that it appears that the same clinical affection can be produced by at least three different organisms. Continuing, we find in some cases the pneumococcus associated with streptococcus (Case 5), with staphylococcus (Case 2), and with streptococcus and some bacilli in Case 11. In Case 12, staphylococcus is found associated with streptococcus and other non-identified organisms. All of which tends to show that these septic neck infections may arise either from a single, but not always the same, variety of organism, or may be a mixed infection of so great complexity as to be impossible of exact identification. Lockwood³ who gave considerable study to the question of infection states that Ludwig's angina is probably a mixed infection of the most complex kind. That this is so is true in some cases, but in many only a single organism, usually streptococcus or pneumococcus, has been found even in typical cases. From these facts we must conclude that the septic infections of the neck which include those classed as Ludwig's angina can be caused either by one of several organisms, as the staphylococcus, streptococcus and pneumococcus, or by a mixture of various forms, including a gas-producing bacillus.

2. How do the infecting organisms gain access to the tissues?

In many cases the mode of access is unknown, but it is practically established that the infection starts from some lesion in the mouth or throat. Most often it starts from the teeth. In many cases trouble with the teeth antedates or coincides with the onset of the infection. In some cases (as in Case III.) the infection follows so rapidly as to leave no doubt as to the causal relation. As pointed out by Semon the infection does not usually involve the nasal cavities. C. J. Aldrich⁴ describes a case that almost certainly started from the tonsil, and this organ has been frequently found involved and another⁵ following a pin scratch of the frænum. He also suggests that the infection involves the salivary glands by being transmitted along their ducts. W. O. Humphrey⁶ also describes a case preceded by tonsillitis. A case by C. M. Harris⁷ suggests an inflammation of the middle ear as being a starting point. The question of mode of origin may be an extremely important one, particularly to dentists. In one of my cases (Case III.) a young lady had an abscess on a lower molar tooth. She went to a dentist who injected a solution of cocaine around the tooth and extracted it. Swelling followed almost immediately and soon assumed the character of Ludwig's angina. It was incised on the fourth day, recovery following. In this case the dentist was accused of having started the inflammation by the use of infected solution or instruments. He stated this was not the fact, as he had used all possible antiseptic precautions. In such a case it is practically impossible for a dentist to demonstrate his innocence. The frequency of infection following trouble with the teeth is such that when a high grade of inflammation exists and an abscess may be forming or already formed dentists will neither extract the offending tooth, nor open the abscess, nor attempt any operative means of relief for fear they should be held accountable for subsequent results.

3. What tissues are attacked?

It is evident that the parts attacked will depend to a certain extent on the location of the breach or injury at

which the infection entered. Semon cites many cases in which the focus of the inflammation involved the tonsil, epiglottis and larynx. In some instances the discharge breaks into the larynx. Œdema of the glottis not infrequently necessitates tracheotomy and may lead to death. When the teeth are the starting point the inflammation involves the periosteum of the lower jaw and thence invades all the surrounding tissues. In many instances (as in Case VI.) the exact point of commencement is unknown and attention is first attracted by the swelling of the tissues of the floor of the mouth and beneath the jaw. While the point at which the infection starts localizes the disease at its commencement, it progressively spreads and involves all the tissues within its scope. No matter how it commences, it spreads along the connective tissues by direct continuity. It is not transmitted by the lymphatics. The lymphatic glands do not become enlarged by infection carried to them by the lymph-stream from the infectious focus, but they are involved in the infected connective tissue surrounding them. In many cases the deep tissues are markedly involved causing a peculiar "wood-like" induration and yet there may be but little or no redness of the skin. This is particularly true early in the course of the disease. As it progresses all the tissues become affected. The bone becomes bare and the soft parts become gangrenous. It is a gangrene of the deep-lying connective tissues and the muscles within them. The process seems to experience difficulty in piercing the deep fascia, hence the skin and subcutaneous tissue are often but little affected. Commonly, particularly early in the disease, there is but little tendency to the formation of pus, and when the epiglottis and larynx are involved, œdema supervenes and causes suffocative symptoms. Early incisions often give exit only to serum and no pus is found. It usually makes its appearance later and is dark colored and peculiarly offensive.

4. How the infection progresses.

As already stated it progresses by direct contiguity of

tissues. Sometimes it begins on one side below and behind the angle of the jaw and passes directly across to the opposite. At other times it passes downward on the neck as far as the clavicles and sternum (Case V.). If it is inside, it soon involves the larynx and tissues around the oesophagus and difficulty in swallowing and breathing may be early symptoms. In fatal cases it follows the cervical tissues down the neck and into the mediastinum and produces a septic pneumonia. The progress of the disease is comparatively acute, often running its course in six to twelve days. It may stop at any time, or it may progressively increase until death is caused by septic infection. In laryngeal cases, death may occur early from suffocation.

5. How it influences the parts locally.

This has already been detailed to a considerable extent. Swelling is the first sign. It shows itself under or behind the lower jaw, in the floor of the mouth, pushing the tongue toward the roof, or in the larynx and epiglottis in the form of oedema. The skin often is normal in color, especially early in the affections and there may be no tendency to the formation of abscesses. In infections from pyogenic organisms, the skin becomes red and rarely considerable collections of pus may occur. It is frequent for openings to occur alongside of the teeth posteriorly and foul, ichorous, pus to exude into the mouth. Later the tissues become gangrenous and may come away as sloughs if the patient survives. If the disease tends to recovery, the local conditions improve with great rapidity, and usually leave no serious results.

6.—How is the system affected?

The affection is primarily a local one, and the general system only becomes involved later. The fever for several days may be moderate, about 101° , but later when sepsis is marked rises to 105° or 106° . These very high temperatures are exceptional. Especially when the streptococcus is the prevailing infecting organism the temperature may not rise above 101° or 102° , even though the case is tending to a fatal issue. In cases of mixed infections the presence of

pyogenic organisms (staphylococci, etc.), may cause the temperature to run higher. At the commencement there is practically no systemic depression but in a few days it becomes marked and deepens to the end. Death may occur either comparatively early from suffocation or heart failure, or later from exhaustion and sepsis. When the disease attacks the larynx death may occur suddenly and before the super-vention of marked septic depression. Whether these deaths are due to suffocation or heart failure caused partly by sepsis and partly by the impeded respiration is sometimes difficult to say.

In one case (Lombard et Caboche⁸) a patient who had had great difficulty in breathing was talking with his wife when on reaching for his handkerchief he suddenly fell over and quickly expired. Case No. IX. died in almost the same manner.

In Robertson and Biedert's⁹ case sudden death occurred after a tracheotomy had been performed, so that suffocation could not have been the cause. In one of Ross'¹⁰ cases likewise sudden death resulted while the opening existing through the larynx was sufficient to preclude respiratory obstruction.

In Case VIII. the dyspnœa was so great as to require tracheotomy and the patient died on the table. These sudden deaths occur usually in patients in which the epiglottis and larynx are affected and the dyspnœa marked. Involvement of the larynx is indicated by the diminution and loss of voice and difficulty in respiration.

The question of the affection being epidemic has been suggested by Seymour Taylor,¹¹ who saw a series of cases in the Hammersmith district. F. Murchison¹² and Klein¹³ also refer to an outbreak in the Hebrides. Klein states that it is not contagious as there were never two cases in the same family. Five of my own cases came from a single section of the city in a period of five weeks. Thus it is seen that while it can hardly be said to occur in epidemics like the infectious fevers, still it does occur sometimes

in groups, and more frequently than at others, as is the case with that other streptococcus-infectious disease, cutaneous erysipelas.

The question of its infectious character is likewise of importance.

Two of my cases resembled erysipelas so much that they were isolated. In fact it would be best if all these cases were isolated. In most instances it is largely a streptococcus infection and acts like erysipelas. Even the cases that show pneumococcus and staphylococcus infection act clinically much like the others and seem to be but little less virulent. Some have been inclined to regard the disease as being a true erysipelas, but this term could hardly be applied to those cases showing only staphylococci or pneumococci. The disease also acts at times like a common pyogenic affection, all signs ameliorating as soon as an incision is made and tension relieved. Would anyone expect a cutaneous erysipelas to act so? It suggests the possibility of curing the latter disease at once by making free incisions into the affected area.

Another character of the disease is that it sometimes shows a tendency to again extend after apparently convalescing. This occurred in three of my cases and in Dr. Ross' case death occurred suddenly two weeks after the case was reported, and the autopsy showed ulceration of the larynx.

Diagnosis.—The question of diagnosis is intimately associated with that of treatment. It is one not so much of character as it is of degree, but even the question of character may be obscure. Many practitioners have never seen nor recognized a bad case of the so-called Ludwig's angina; as a consequence, in its early stages particularly, it is apt to be unrecognized and energetic treatment deferred until too late. Statistics are practically useless. A septic infection is dangerous according to its extent, and these infections occur in all grades. If mild cases are seen the mortality is slight and if serious cases are seen the

mortality is high. In the ten cases here recorded four died, a mortality of 40 per cent. It must be borne in mind, however, that many light cases which recover are not considered to be of the kind we are now discussing. In making a diagnosis of inflammatory and cedematous affections of the throat and neck, it should be borne in mind that one class of cases as already stated is local in character and usually remain local and do not show the same tendency to spread through the medium of the connective tissues as do the other. Those arising from mechanical and chemical irritants, from interference of the blood-supply producing cedema; from surface inflammations as glossitis, stomatitis, pharyngitis, laryngitis; from inflammations of neighboring organs as the tonsils, salivary and lymphatic glands, syphilitic and tuberculous ulcerations may all be confounded with acute septic infection. In some cases it is impossible to draw the distinguishing line particularly in the early stages, yet it is essential that the true character be recognized as soon as possible, because one class tends to pursue a comparatively benign course while the other pursues a decidedly dangerous one.

The onset of the affection is often insidious, yet some cases are fulminating. That of Biedert and Robertson completed its fatal course in ten hours.

The disease produces local signs before general symptoms, and attention may first be attracted by a swelling which may be either below the jaw in the submaxillary region or posteriorly over the parotid region. The hard "board-like" character of the swelling is almost pathognomonic. Sometimes the skin is pale, sensitiveness not marked, and the temperature raised but one or two degrees. In other cases the skin may be a dusky red, tender, hard and painful to the touch, and the temperature high, 102° or 103° . Swelling of the floor of the mouth pushing the tongue upward to the roof and forward, with difficulty in swallowing and some difficulty in breathing, are early noticed. Chills may occur and dirty offensive pus may

break into the mouth near the molar teeth. The swelling may extend down to the clavicle and up on the temple and a large abscess may form beneath the lower jaw. The temperature rises and death from sepsis follows usually inside of twelve days. Death may occur early from involvement of the larynx, this involvement being indicated first by a hoarseness of the voice and then by its loss. The progressive involvement of the deeper tissues should settle at once the question of diagnosis.

Treatment.—I am firmly convinced that the disease in its early stage is a purely local affection whose extension can be promptly cut short by fearless surgical treatment. Procrastination and timidity as well as a failure to recognize the dangers of delay, are the undoubted causes of the loss of many cases. Fears of unnecessarily scarring the patient or of encountering alarming hæmorrhage both suggest delay. He who waits for the formation of pus before incising waits too long. When a case presents itself with a hard board-like swelling beneath the jaw it is evidence of probable cellular-tissue infection. Administer primary anæsthesia with ethyl chloride, ether or chloroform, and make an incision in the median line between the symphysis and the hyoid bone and carry it through all the tissues; better all the way into the mouth, at least until the point of the knife can be recognized by the finger inside the mouth beneath the tongue. This incision is easily made, devoid of danger, is accompanied by no hæmorrhage, and drains effectively the infected area. If it is made early no pus will be found but only blood, or a little thin serum. The relief, however, is immediate. If the swelling is more toward the angle of the jaw, or in the parotid region, then incise the skin and with a pair of hæmostatic forceps bore slowly into the swollen tissues, expanding the blades and if necessary inserting drainage tubes. In very bad cases the larger the incisions the better, and one or two of my own could probably have been saved had this been done instead of relying on drainage tubes. In this affection pus does not often show a ten-

dency to accumulate, and the large incision relieves tension and allows the gangrenous tissues to be cast off.

In œdema of the epiglottis and larynx, ice and inhalations (spray) of cocaine and adrenalin may be of service, but tracheotomy should not be deferred too long. A high tracheotomy is probably just as efficient as a low one, and much less dangerous. In one of the cases here recorded death ensued on the table from hæmorrhage, and this is hardly to be wondered at when we recall the vessels which may be encountered. The large distended inferior thyroid veins, an anomalous thyroid artery, an innominate slightly more to the left than usual, or a high left innominate vein crossing above the top of the sternum, may any one of them cause a fatal issue.

CASES.

CASE I.—Young woman, aged 22. Was admitted for a swelling of face and jaw. An examination of the mouth failed to reveal any cause for the infection. There was no evidence of carious teeth, tonsilitis or other focus of infection. About a week previous to admission she noticed that the side of her face was swollen, principally behind the angle of the jaw. It rapidly involved the whole neck and both sides of the face. It was slightly red, hard and somewhat painful. It had been poulticed. She could hardly swallow, the voice was altered and hoarse, the tongue swollen, and the jaws could be separated only a half inch. Temperature was 101.3° .

An incision was made in the median line beneath the chin, extending into the mouth, and another behind the angle of the jaw. No distinct pus was found but the next day very thick, offensive pus discharged. The swelling and temperature rapidly diminished and the discharge had almost ceased by the twelfth day, when her temperature rose to $100\frac{3}{5}^{\circ}$ and the swelling again returned to again disappear after a few days.

An examination of the pus showed it to be a pure streptococcus infection. (See Fig. I.)

CASE II.—A Russian, male, aged 26, was brought to the Episcopal Hospital with the history of having had several teeth extracted from the back part of the left lower jaw. About



FIG. 1.

four hours later the jaw became swollen and two days afterwards the right side became swollen and painful. On admission, he was unable to speak English, both jaws were swollen, breath was fœtid, and stinking pus was escaping into the mouth from the left molar region. The patient looked very ill. Tongue was coated. Urine 1026, with marked reaction of albumen. An incision below the angle of the jaw gave exit to a small quantity of foul pus. He swallowed with difficulty, his respiration became jerky and hurried, varied from 102° to 104° and once went to 106°. He died of sepsis nine days after admission.

The color of the skin in this case was pale rather than red, and at no time was there marked evidences of any accumulation of pus. It is barely possible that more free incisions would have benefited this case.

CASE III.—A young woman, aged 24 years, had a lower right molar tooth extracted for an abscess of its roots. The dentist injected cocaine into the gums. Within an hour after the extraction the cheek began to swell. On the next day cold was applied and a mouth-wash used. The day following she was somewhat better, but on the fourth day the swelling got worse and the pain increased. Leeches and ice were applied but on the day following the swelling extended from ear to ear around under the jaw; it was tender, a little red and quite brawny, and hard to the touch.

An incision was made between the hyoid bone and the symphysis, extending to the mucous membrane of the mouth just below the tongue. No pus was obtained.

During the night the patient had considerable difficulty in breathing, but in the morning a free discharge of pus made its appearance and immediate relief followed.

In six days after incision the discharge of pus ceased and she was practically well. Her temperature during the attack ranged from 101° to 102.8°.

The dentist stated that he used a fresh solution of cocaine and sterilized instruments in injecting it.

The immediate following of the inflammation after

the extraction looks like cause and effect and the course after incision demonstrates its efficacy.

CASE. IV.—A young man, aged 19; had, two weeks prior to admission, pain in the teeth and swelling of the jaw. The last molar on the affected side was decayed. The swelling began at angle of the jaw. He could hardly open his mouth. Urine Sp. Gr. 1027; trace of albumen; no sugar; no casts. Temperature 104.6°. An incision was made below the angle of the left side of the jaw and considerable pus was evacuated. About two weeks later the left side again became swollen, his temperature rose and he looked ill. The swelling was red and indurated and the breath foul. A small amount of pus escaped from the original incision. The symptoms gradually abated and in six days he was discharged cured.

It will be observed that this patient also had a relightingening up of the trouble after the subsidence of the first attack.

CASE V.—A young man, aged 20; had for some time a bad tooth in the right side of the lower jaw. Eighteen days prior to admission the right side of the neck began to swell and on admission the neck was enormously swollen extending from the zygoma above to the clavicle below, and from the right ear around the neck to beyond the median line. Voice hoarse; could not breathe lying down, and had marked difficulty in swallowing. His temperature was 101°, pulse, 120, respirations 24. General condition, good.

Two incisions were made, one in the median line and the other beneath the angle of the jaw. Practically no pus was obtained. He had to sit up all night, but his dyspnœa gradually disappeared. Two days later there was a small amount of pus, which showed streptococcic infection.

On the fifth day his temperature was normal and on the tenth day he was discharged with the wounds not yet closed.

Another example of the efficacy of free incisions and deep exploration with a hæmostatic forceps. (See Fig. II).

CASE VI.—A man, aged 23 years, was admitted to the hospital for typhoid fever, having been ill two weeks. Seven days after entrance while feeling much better it was noticed in the

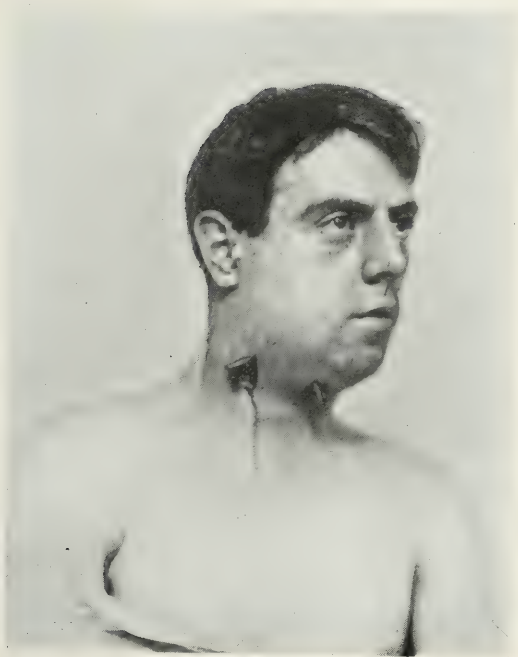


FIG. 2.



FIG. 3.

morning that his face looked fat. By three o'clock in the afternoon the neck was swollen, hard and tender in the submental region. He could only open his mouth half way. Leucocytosis of 12000. No growth on the tonsils. The next day swelling was more marked and indurated nearly to the sternum. He was beginning to have difficulty in respiration. An incision was made through the swollen parts between the symphysis and hyoid bone, extending through into the mouth. A considerable amount of thin brownish-green discharge escaped. Cultures of streptococci, staphylococci and pneumococci were obtained from the mouth and streptococci and staphylococci from the wound discharge. The day following the wound was discharging pus freely and pus was also discharging from the right ear. The next day he was still better but the following day the neck again swelled, became red and looked like erysipelas. He then passed through a regular attack of cutaneous erysipelas, which lasted three weeks. It spread up over the left side of the face and closed the left eye. Then the wound healed but the right side of the face began swelling, involving the left eyelids. An abscess formed in the left eyelid and discharged gray pus. An abscess formed in the left molar region and was opened, and the left ear also discharged pus. The erysipelas finally disappeared and the patient recovered. (See Fig. III.)

This was a case of mixed infection. The erysipelas was a typical attack and I regard it as not being a new infection from without but a direct extension by continuity of tissue of the streptococcus infection which began in the submental region. A case like this goes far to prove that the original infection was much the same as occurs in ordinary erysipelas. This is the third case in the series in which a subsidence of the original attack was followed by a secondary outbreak.

CASE VII.—A man aged 48 years had been attending the outpatient department of St. Joseph's Hospital for an infected wound of the finger. He was absent for some time and was returned to the hospital in such a septic and depressed state that no history could be obtained. The left side of his face in the parotid region and behind the angle of the jaw was hard

and swollen but not very red; œdematous and tender on pressure.

The mouth was partly open, tongue coated, teeth in bad condition and a foul discharge of pus along the posterior portion of the left lower molar teeth. The index-finger of the right hand contained a small quantity of pus. Heart and lungs negative. Urine 1020, acid; albumen 4 per cent. ; no sugar.

Temperature on admission 98.6°; next day it went to 106.4°. It varied between these extremes with chills until he died on the sixth day after admission. The swelling invaded the temporal region and rales appeared in the lungs and then he died from sepsis. He was treated by incisions and a large drainage-tube from the angle of the jaw into the mouth.

This case was pyæmic on admission, and it is doubtful if any treatment would have saved him; but it is probably worth while in such cases as this to make a long incision from below the ear, behind the angle of the jaw and as far forward as the swelling extends. I believe drainage by means of tubes is insufficient and wide-open incisions are required.

CASE VIII.—This case I saw but did not treat. He was a man, aged 35, an engineer, who was brought into the hospital drunk. He had a swelling beneath the jaw and was transferred to the surgical wards. The swelling rapidly increased, accompanied by attacks of dyspnœa.

The mouth and throat was sprayed with a solution of cocaine, adrenalin and menthol. On the fourth day he had such a severe attack that tracheotomy was attempted but he died on the table from hæmorrhage.

When death occurs from suffocation it is usually not as in this case from an acute paroxysm but more usually by a gradual shutting off of the air until the overloaded heart simply gives out. This case illustrates the difficulties and dangers of performing tracheotomy when the neck is greatly swollen.

CASE IX.—Was admitted under the care of my colleague, Dr. Edsall. It was a man, aged 42 years. He retired one night apparently well, but was awakened the next morning being scarcely able to breathe and having a violent rigor. He could only lie a short time and then had to sit up. He felt as if there was a lump in the throat. He stated that there had been a lump on the right side of the throat, which broke and allowed a lot of foul material to run down his throat. On admission he was short of breath and had a hard mass on the left side of the neck. No fluctuation or other evidences of suppuration. Uvula much swollen and oedematous. Tonsils could not be seen. The swelling was incised but no pus was obtained. Thorough drainage by means of a tube was employed, which gave some relief. Urine 1023, acid marked, trace of albumen, no sugar. He died apparently of suffocation, suddenly, on the second day after admission and the fourth day of the disease.

Another instance of the apparent inefficiency of the drainage-tube.

CASE X.—Was under the care of my colleague, Dr. Frazier. It was that of a man, aged 61 years. A decayed loose tooth had been occasioning the patient some trouble and a week before admission he had had considerable pain in the lower jaw. A swelling began under the jaw, which was painful and very hard. He had difficulty both in breathing and swallowing.

On admission there was a hard swelling under the chin, extending down to the larynx. The breath was extremely offensive. There was redness and swelling under the tongue. The loose tooth from which the trouble originated was still in. The swelling was incised and a thin watery material oozed out, along with blood. There was no free pus. Three openings were made and two rubber tubes were put in as drains and a hæmostat was thrust in several directions and opened and drawn out. Very little thin, watery, offensive fluid escaped. Considerable of this same foul-smelling material was later seen on the dressings. Considerable relief was obtained from the operation. At one time the patient was expected to die, but eventually recovered after a stay in the hospital of nine days.

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TOTAL LARYNGECTOMY FOR CARCINOMA.

REPORT OF A RECENT SUCCESSFUL CASE.

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THE patient, C. E. W., aged 46 years, had always enjoyed good health up to the present trouble, which began two years ago, when he first noticed that he was gradually getting hoarse. He consulted his family physician, Dr. G. N. Ferris, and was under his care for about six months. At the end of that time he was referred to Drs. C. C. Rice and Ferguson, of New York, under whose care he has been since that time. In the beginning the case was regarded as a papilloma of the right vocal cord, and eight months ago it was removed by Dr. Rice, resulting in immediate restoration of the voice. In about two months, however, the hoarseness returned, and the growth was again removed; this second operation was again followed by a return of the hoarseness in about two months, and in spite of local treatment, the growth persisted. It was now apparent that it was malignant in nature, and the advisability of a more radical operation was suggested. The condition of the laryngeal involvement, when the patient came under the writer's care, is shown in the accompanying sketches (Figs. 1, 2 and 3).

After consultation with Drs. Rice and Ferguson, who gave me the foregoing history, and with Dr. P. H. Sturgis, who saw the case with me, and after looking up the literature upon the subject, particularly an article by W. W. Keen,¹ of Philadelphia, the writer advised a total laryngectomy, for the reason that the operation as described by Keen appealed to us as being by far the most rational surgical procedure to adopt in such a case; there being, as he says, but one objection, namely, the loss of voice, which we believed should not be considered in dealing with a malignant growth of the larynx. The question is not, shall the patient talk, but shall he survive the operation, and

¹ ANNALS OF SURGERY, Vol. 30, 1899

the danger of recurrence be reduced to the minimum. Having explained to the patient the danger of the operation and the disability that might result therefrom, he requested that it be done. The larynx was totally removed by me on April 18, 1906, with the assistance of Dr. J. B. Bogart, at the Methodist Episcopal Hospital in Brooklyn.

The shoulders having been slightly elevated to extend the neck, the patient was placed under chloroform anæsthesia. An incision was then made, extending from the body of the hyoid bone to the episternal notch, and the larynx and trachea exposed to a point just below the cricoid cartilage; the soft parts were then dissected away from the larynx well back to the œsophagus. The hæmorrhage, which was not great and came principally from the upper border of the thyroid isthmus, was now controlled. The patient was placed in the Trendelenburg position, and the trachea divided just below the cricoid cartilage, and immediately sutured to the skin by two chromic gut sutures, one on either side.

Some coughing, which followed, was immediately controlled by the application to the tracheal mucous membrane of a solution composed of equal parts of one to one thousand adrenalin solution and 4 per cent. eucaine. The larynx was then lifted up by the finger and rapidly dissected from the œsophagus up to its upper border. The thyro-hyoid membrane, together with the other structures attaching it to the pharynx, were then divided, and the organ removed. The epiglottis, which was not involved, was spared. The upper margin of the pharynx was now attached by a double row of cat-gut sutures to the tissues just below the hyoid bone; the first row of plain cat-gut to secure approximation of the mucous membrane; the second of chromic gut to secure firm apposition of wound surfaces. The soft parts were then sutured from above downward with interrupted cat-gut sutures, and the skin by a chromic subcuticular. A drain was now brought out at the lower angle, and two more chromic gut sutures were introduced, uniting the trachea more firmly to the skin.

The entire operation lasted forty minutes, the excision itself taking twenty-five minutes. No further anæsthetic was used after the trachea was divided during the remaining fifteen minutes occupied in closing the wound, and none was necessary,

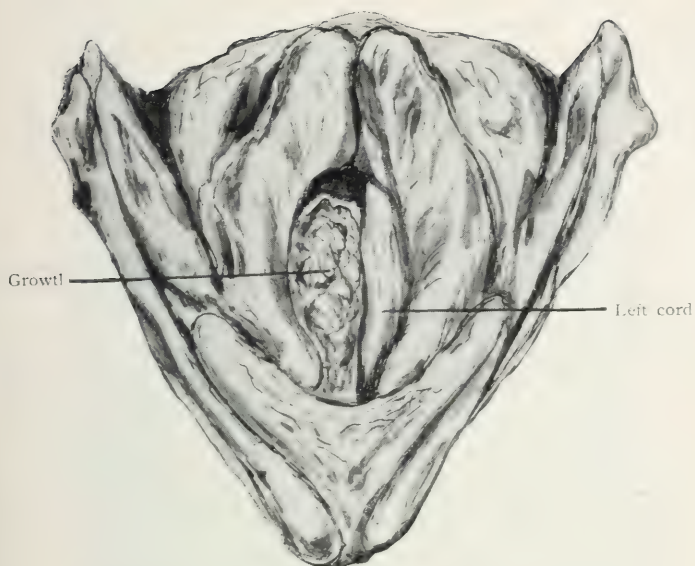


FIG. 1.—The larynx and growth as it appeared from above.

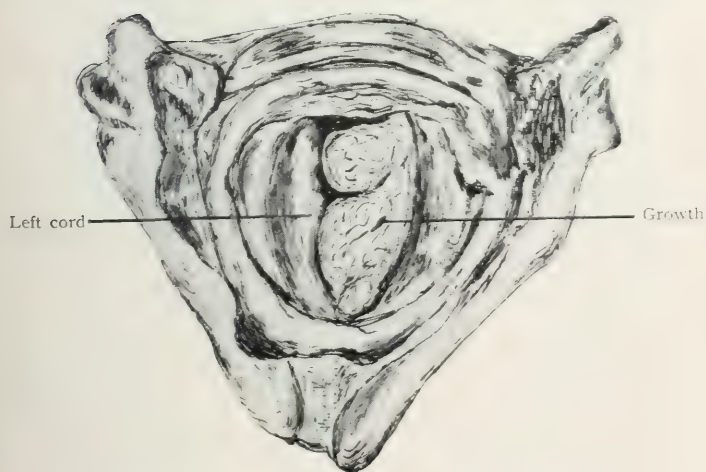


FIG. 2.—The larynx and growth as it appeared from below.

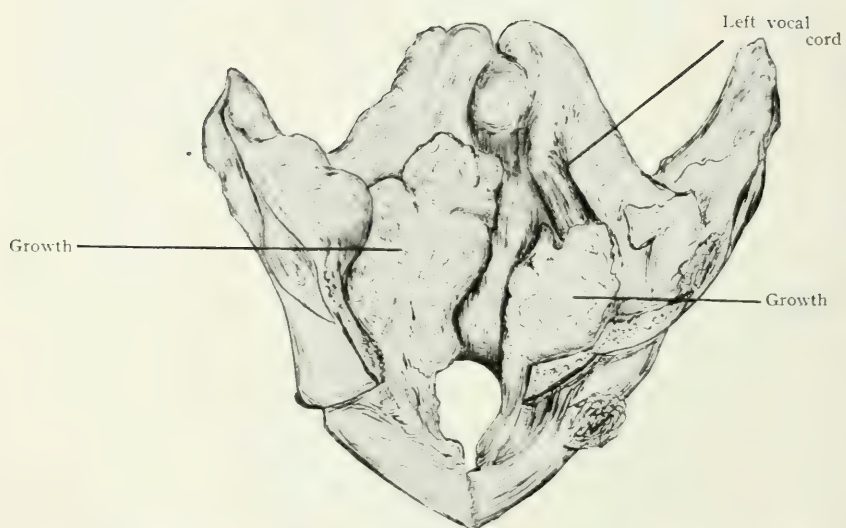


FIG. 3.—The larynx split open anteriorly, showing the growth involving the right vocal cord and extending to the left.



FIG. 4.—Present condition after laryngectomy. Tracheal aperture in midline of the neck.

although the patient was partially conscious of what was going on. He suffered no particular shock. His pulse at the beginning of the operation was ninety-eight; at its completion, one hundred and twelve.

A simple piece of sterile gauze was placed over the tracheal wound; the sutured portion was sealed with collodion, and the patient was placed in bed in the Trendelenburg position.

On the third day he sat up in bed, and on the fourth he sat up in a chair for an hour. The temperature rose on the day following the operation to $102-2-10^{\circ}\text{F.}$, but did not go above that point, and gradually fell to normal on the tenth day. He was fed by rectum for thirty-six hours. At the end of that time he could swallow liquids in half-teaspoonful doses with some difficulty, as it required two or three efforts to get it down. He continued to swallow with greater ease until the seventh day, when it was found that a few drops of the liquid came through, and ran into the trachea causing him to cough. After this all nourishment was given in the Trendelenburg position for six days. At the end of that time, the leak had completely closed, and he was able to take food as usual. With the exception of the leak above mentioned, the wound healed by first intention throughout.

Microscopic examination of the growth after removal confirmed the diagnosis of carcinoma.

The operation as described is practically that suggested by Keen. At the conclusion of his article, however, he says, "In my next case, after dividing the trachea transversely, I shall quickly attach the tracheal stump to the skin. Then I shall introduce the ordinary tracheotomy tube into the open end of the trachea, instead of through a tracheal wound, and continue the anæsthetic through the tube." This step we omitted entirely, and completed the operation without the use of a tracheotomy tube or anæsthetic. In fact, our patient has never worn a tube up to the present time. Whether it may be necessary in the future, remains to be seen.

It certainly was not necessary at the operation, and by its omission I am sure we were relieved of some embarrass-

ment. The drain, if one is used at all, should be brought out at the center of the wound, and not at the lower angle. In this position it soon becomes foul, and prevents primary union at this point. Had the wound been sutured well down to the tracheal opening in this case, the fluids would have been prevented from entering the trachea when the leak occurred, but would have escaped through the drainage opening. In using the absorbable sutures throughout, we adopted the suggestion of Keen, as the silk used by him gave trouble.

In conclusion, we would say as the result of our experience in this case, that neither preliminary tracheotomy nor tampon-canulæ are necessary in these cases to prevent blood from entering the trachea; that the advantages of the Trendelenburg position, both at the operation and in the after treatment, cannot be overestimated, as it absolutely prevents blood or secretions from entering the trachea; that the use of even an ordinary tracheotomy tube may, with advantage, be dispensed with.

I am indebted to Dr. H. G. Webster for the drawings, and to Dr. C. F. Buckley for the photograph.

THE TREATMENT OF DIFFUSE SUPPURATIVE PERITONITIS, FOLLOWING APPENDICITIS.*

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THERE is perhaps no question in modern surgery of greater interest and importance and about which there is greater disagreement than that of the treatment of diffuse peritonitis.

The utter impossibility of draining the general peritoneal cavity does not seem sufficiently obvious to many surgeons, and the nature of the peritoneal reaction to drainage is but imperfectly understood.

The writings upon this subject consequently, have often been more or less tinged with prejudice, and only too frequently with an apparent lack of comprehension of the physiology and mechanics of peritoneal absorption. The peritoneum is generally regarded as a vast lymphatic space of great absorptive power, but Muscatello has shown that the older theories of absorption, through the so-called stomata, between the endothelial cells, was wrong; and that the stomata were merely artefacts. He showed, also, that the greater part of the peritoneal sac is not underlaid with lymphatic spaces, but that these are confined principally to the peritoneum covering the diaphragm. He demonstrated moreover, that there is normally a flow of lymph toward the diaphragm, and that this is uninfluenced, save in point of time, by gravity. The same observer also noted that colored particles in fluid, experimentally injected into the peritoneum, were taken up, first, into the pits of the dia-

*Read at Meeting of New York Surgical Society, April 11, 1906.

phragmatic peritoneum, and then into the lymph spaces beneath it by means of phagocytes.

To show the rapidity of peritoneal absorption, Dubar and Remy were able to recover particles of carmine, from the thoracic duct only seven minutes after intraperitoneal injection.

The irritation of the peritoneum by foreign substances becomes then the signal for the immediate delivery into the peritoneal cavity of a large quantity of phagocytes, whose number depends largely upon the character of the irritant, as well as, to some extent, upon the time elapsed.

Provided the endothelium is uninjured, bacteria and other foreign substances can be safely disposed of, within limits of course, by the lymphatic route through the crura and central tendon of the diaphragm. Damage to the endothelium, however, may at once lay open the vascular route through opened blood-vessels, and permit of absorption sufficient to cause a fatal septicæmia. This is believed by some observers to be a real danger in peritonitis.

Fortunately, however, the patient's safety in peritonitis does not depend solely on the integrity of the endothelium for there is also, in most cases, a protective fibrinous deposit, gross or microscopical, which limits absorption into the peritoneal blood-vessels, and, at the same time, prevents the further egress of germs from the lumen of the intestine. The absence of this fibrinous deposit, noted in bad cases of streptococcus infection, denotes the absence of an important barrier to general infection through the blood-stream, and the fatality of these cases as is well known, is disproportionately great. This great power of peritoneal absorption then is one of the factors upon which we must depend for comparative safety in all abdominal operations, and upon its proper conservation depends the surgeon's success or failure.

That which happens as a result of the introduction of micro-organisms into the peritoneal cavity, depends upon their virulence and power to damage the endothelium and

so gain access to the tissues beneath, upon the power of the individual to furnish a competent protective leucocytosis, upon the stimulating action of the body fluids, and upon the ability of the phagocytes to deal with the organisms. (Dudgeon and Sargent.)

As appearances at operation furnish no very exact information as to the extent of the peritonitis present, it has been thought best by the writer to indicate in a general way what class of cases he has collected for discussion.

1. In all cases free pus was present, and its limits were not generally definable.

2. The ability to wash out pus from the pelvis, splenic pouch, and various parts of the lower abdomen was taken as evidence of involvement of the peritoneum in those regions.

3. Large secondary encapsulated pelvic collections of pus are not included.

The cases under consideration include all those cases of diffuse purulent peritonitis in which the limits of the pus are extensive but not easily definable, and in which it is free and unencapsulated, except of course, within wide limits. A reference to the histories of the cases appended will show a number of primary diffuse suppurations, a number secondary to the rupture of primary appendiceal abscesses, and in all of them it will be observed that the process is extensive, diffuse, purulent, and rapidly generalizing.

The review of the rise and fall in the popularity of peritoneal drainage is well presented by Yates,¹ of Chicago, in a masterly paper on "An experimental study of the local effects of peritoneal drainage." He details most graphically the methods in vogue from the time of Celsus to the present, and notes the influence of the earlier operators upon later methods of procedure. His conclusions derived from a most careful series of experimental studies in animals, are so closely in accord with my own, which have been

¹ Surgery, Gynecology and Obstetrics, December, 1905.

reached as a result of clinical observation, that I can only recommend a careful study of the whole article.

The experimental work of Clarke, confirming the earlier demonstration of Muscatello, as to the rapidity and efficiency of the absorption of micro-organisms through the lymphatic spaces of the diaphragm, is well known. The discussion and interest evoked by the paper of Blake on the treatment of peritonitis before the American Surgical Society two years ago, the work of Morris, Murphy, McCosh, and others, is also well known. The criticisms of my own methods of treatment as given in a paper read in March, 1904, before the Buffalo Academy of Medicine, "A consideration of the question of drainage in cases of acute appendicitis with spreading peritonitis," show that the question is by no means settled in the minds of the majority of the profession. Hence the variation of procedure from the method of Ochsner, who aims at encapsulation, and late removal of the appendix, to the radical methods still in vogue in this country and abroad, of wide incisions, evisceration, and washing and draining of the peritoneum. The general feeling seems to be, when in doubt drain, but the factor of doubt becomes at once a personal one, based often not upon any strong conviction but upon the following out of routine methods, and taking very little consideration of the physiology of peritoneal absorption, or settled by prejudice in favor of some method which has yielded fairly good results.

Men who have departed from the beaten track of belief as to the efficacy of intraperitoneal drainage by gauze or other means, and who have claimed better results by radically different methods, have been doubted and assailed. In my paper of March, 1904, already referred to, I reported 114 cases of appendicitis, in the service of a single hospital. In the first group extending over my terms of service from 1895 to 1899, there were 42 operations, among which there were 12 cases of *diffuse peritonitis with 11 deaths*. These latter cases were treated as was common at the time, by

free opening, more or less evisceration, saline irrigation, and drainage.

The second group, 72 cases from 1899 to 1903, showed 15 cases of *spreading peritonitis with no mortality*. These were treated by rapid removal of the appendix, generally through the muscle split of McBurney with as little traumatism as possible, developing the appendix by touch often rather than by sight, and discarding the broad protective packings of gauze to prevent soiling. Free irrigation of the pelvis and lower abdomen with hot normal saline solution, was done and closure of the wound to a small cigarette drain to the pelvis and appendiceal site. Before completing the work upon this series of cases, it had become evident to me that the cigarette drain or drains by reason of their rapid encapsulation acted mainly as a wound drain and had no real function as a peritoneal drain when it was possible to remove all local necrosis. Relying upon this clinical experience, the writer believes that the peritoneal drain can be eliminated as a factor of importance in the treatment of diffuse suppurative peritonitis. The observations of Blake, LeBoutillier and others will, I think, bear me out in this.

In the series of cases reported herewith and which have been operated upon since the beginning of 1903, 28 cases in all of diffuse suppurative peritonitis, the method of procedure has been as follows:

The McBurney muscle split, with or without the Weir extension through the posterior sheath of the rectus, has generally been found sufficient for the necessary manipulations.

As little ether as possible has been administered, and every effort has been made to complete all peritoneal work with as much speed and as little traumatism as possible. The appendix has been systematically searched for and removed with as little disturbance to the intestines as need be. After its removal and the cleansing of the appendiceal site, the pelvis and lower abdomen have been rapidly washed out with the Blake tube or the jacketted glass return-flow

canula. The peritoneum has been closed in many cases, without attempting to remove the saline solution which had not run out. Drainage of the external wound down to the peritoneum has generally been employed, from the fact that the wound is generally infected and needs it. Gastric lavage is given before the patient leaves the table, and as a rule an ounce or two of saturated solution of Epsom salts has been introduced through the tube and left in the stomach. Morphia as far as possible has not been given and the rectal tube with saline irrigation of the lower bowel has been used generally every six to eight hours for the first two days. If vomiting occurs, the stomach is washed out.

It has required some courage based upon strong conviction to close the peritoneum in these cases even when feeling sure that no area of local necrosis was left behind; but the results seem to have justified the means, and the writer feels that the mortality has been much diminished and the time in hospital much lessened, a factor of no inconsiderable importance. The Fowler position, based, as it seems to me, on entirely false premises as to the ability to pool and drain the peritoneal secretions, is nevertheless often a most valuable aid in that it increases the comfort of those patients in whom the distention of the bowel makes breathing difficult by upward pressure upon the diaphragm.

The use of saline irrigations to the peritoneum, as described, through the small lateral incision, does not consume much time, and seems by diluting the remaining fluids to hasten their absorption, besides acting generally as any intravenous infusion would to hasten the removal of toxins by dilution besides stimulating the heart and circulation. Moreover, the actual ability of the peritoneum to cope with the inflammation seems to be increased and not hindered. In those cases where the inflamed appendix is the cause of the peritonitis, the problem resolves itself into the rapid removal of the offending organ without evisceration, in all cases. The peritoneum has proven itself abundantly able to take care of the resulting inflammation, and drainage in

the absence of local necrosis is often ill advised and not based upon sound physiology or mechanics. Gauze packing is not only unnecessary but frequently harmful, being probably responsible for increased mortality, not to speak of the incident damage to the endothelium, with the resulting adhesions.

Where there is an area of local necrosis which is not removable it must of course be isolated, and the area drained on general surgical principles. Of course there is a point in all cases beyond which any interference is useless, as the patient is generally septic and dies whatever may be done. The factor of personal resistance is always an unknown quantity, and cannot be accurately estimated. The virulence of the infection unquestionably cuts an important figure in all cases, but this also is not to be determined at the time of operation, and the surgeon has to deal with the conditions present in each case and rely upon the resistance furnished by the individual phagocytosis and try and not disturb or upset the natural reparative powers by unnecessary traumatism in handling or exposing the intestines.

The experience of Murphy in dealing with these cases by rapid removal of the appendix through the lateral incision, the making of a small median incision and introducing a drain into the pelvis and sitting the patient up is very suggestive. While this method may seem to differ widely from the one herein detailed, the essential part in each seems to lie in the rapid appendectomy with minimum of trauma and exposure, and the reliance upon the peritoneal leucocytosis to accomplish the rest, the relief of tension alone in some cases being unquestionably all that is necessary to prevent further absorption and extension. The work of Clarke and Norris seems to show that saline solution within the peritoneum does not increase but minimizes the danger of pyogenic infections. In addition to the reduction of mortality, the convalescence of the patient is certainly rendered much more comfortable by reason of the rapid elimination of ether from the circulation, the reduction of

thirst, and the increase in the secretion of urine diminishing the bladder irritation.

The following brief reports will indicate exactly in what class of cases the writer has employed the treatment detailed.

The whole number of cases of diffuse peritonitis reported is 28, of which 5 died. Of these at least 3 were practically moribund, one had probably pneumonia present at the time of operation, and one was the subject of an extensive lung tuberculosis, in addition to an extensive perforative peritonitis in which no tendency to the formation of limiting adhesions was present.

These 28 cases in addition to the 15 already reported, in which a similar mode of operating was adopted, form a group of 43 cases of diffuse suppurative peritonitis resulting from appendicitis, with a mortality of 5, or a little over 10 per cent.; a creditable showing, when the class of cases, in which there must always be an appreciable mortality, is considered.

The writer does not believe that the treatment of these cases has yet reached the most satisfactory solution, but he does believe that the secret of success lies in the rapid removal of the cause with as little possible interference as may be, with the great natural protective forces of the peritoneum, the avoidance of drainage which in many cases may prove a menace instead of a help, and in relying upon the great natural powers of the inflamed peritoneum to cope with the infection.

SYNOPSIS OF CASES.

I. *Fatal Cases.* 1.—Ruth N., aged 7, admitted to Hood Wright Hospital April 20, 1903. Died April 21, 1903. Acute seizure, twenty-four hours; no vomiting, moderate distention, general tenderness, no mass. Rales present both sides of chest, condition very poor. McBurney incision with Weirs extension. Appendectomy. Free, thin, flaky pus everywhere; intestines, no adhesions; peritoneum washed out; cigarette drain to appendiceal site. Continued to sink, and died in a few hours.

2.—Lizzie A., acute appendicitis, general suppurative peritonitis. Oblique incision, free pus everywhere, no odor; small perforation of appendix, no gangrene. Patient very sick. Quick operation. Appendectomy. Peritoneal lavage; drain. Died. Hood Wright Hospital, December 9, 1903.

3.—Mr. L., aged 40, subject of extensive lung tuberculosis; acute perforative appendicitis, twelve hours before. McBurney incision; large perforation of appendix, well generalized peritonitis; washed out with Blake tube; peritoneum closed; gastric lavage; Epsom salts. June 10, 1905.—Died of urinary suppression and sepsis, June 15, 1905. Roosevelt Hospital.

4.—Florence B., aged 17; sick one week; left-sided pain. Very sick; marked distention, face and extremities congested, temperature 104°; pulse 130; urine shows albumen and casts. Immediate operation. Incision through right rectus. Cæcum well to left; appendix perforated and exuding fæces. Appendectomy. Free pus everywhere. Saline irrigation with Blake tube; cigarette drain to stump. Died seven hours later. Roosevelt Hospital. August 16, 1905.

5.—Female, aged 42; Roosevelt Hospital September 18, 1905. Perforated appendix, well generalized suppurative peritonitis, W. B. C. 14000. Feeble pulse, cold extremities. McBurney incision; appendectomy. Irrigation with Blake's tube; gastric lavage; cigarette drain to site of appendix. Operation, 15 minutes. Died.

II. *Cases which Recovered.* 1.—Josephine H., aged 12, Hood Wright Hospital, March 13, 1903. First attack, fourth day. McBurney incision; appendectomy. Appendix perforated and gangrenous, free pus pelvis and left side, no limiting adhesions. Washed out with normal saline solution; gastric lavage, Epsom salts introduced through tube; cigarette drain to stump. Discharged well, April 5, 1903.

2.—Henry D., June 30, 1903. Subacute onset, then sudden severe pain and rapid peritoneal involvement; temperature 101°; pulse 123; respiration 32. McBurney incision, appendectomy. Appendix, gangrenous, perforated, concretion. Free pus washed out from below liver, pelvis, and left side; cigarette drain to stump; gastric lavage, with Epsom salts left in stomach. Discharged well, August 10, 1903.

3.—Acute appendicitis; advancing suppurative peritonitis; Roosevelt Hospital, August 12, 1903. Appendectomy, through McBurney incision; washing out with Blake tube, peritoneum closed by suture; external wound drained by cigarette. Cured. August 12, 1903.

4.—Child; acute appendicitis, free pus. Appendectomy; McBurney incision; irrigation with Blake tube; peritoneum closed; wound drained. Cured. Roosevelt Hospital. August 24, 1903.

5.—Male, aged 10; perforative gangrenous appendicitis, acute seizure; collapse, followed by pain, etc. McBurney incision with Weir extension. Appendectomy. Local abscess about appendix, which was gangrenous, and perforated; free pus; peritoneal irrigation with hot saline; peritoneum closed; wound drained. Cured. Hood Wright Hospital. October 13, 1903.

6.—Dwight C., aged 10; acute perforative gangrenous appendicitis; fecal concretion; free pus. McBurney incision; peritoneal irrigation; gastric lavage; drain. Cured. October 16, 1903.

7.—Florence D., acute gangrenous appendicitis; perforation spreading purulent peritonitis. McBurney incision; appendectomy. Saline irrigation; free stinking pus; cigarette drain. Cured. December 26, 1903.

8.—John K., aged 16; acute appendicitis; free pus, also large retrocecal abscess. McBurney incision, with Weirs extension; saline irrigation of peritoneum, also lumbar drain for retrocecal abscess. Secondary operation for secondary peritoneal pus collections. Cured, 51 days. December 27, 1903.

9.—Leo G., gangrenous perforative appendicitis abscess, advancing purulent peritonitis. McBurney incision; appendectomy. Free thin pus widespread; irrigation; peritoneum closed. Cured. January 5, 1904.

10.—Maggie J., aged 25. November 30, 1904. Gangrenous appendicitis, perforative; spreading purulent peritonitis. McBurney incision; irrigation; peritoneum closed. External wound drained. Cured.

11.—Mr. S., aged 58, seen in consultation fourth day; acute appendicitis; tender both sides; marked abdominal distention. To Roosevelt Hospital. Immediate operation. Mc-

Burney incision; appendectomy. Large amount of free pus under pressure spurted out; appendix had multiple perforations; widespread peritonitis practically entire lower abdomen. Blake tube irrigation, gastric lavage, with salts, repeated next day; cigarette drain to stump. Discharged well, March 4, 1904—3 weeks.

12.—Edwin M., aged 16. Roosevelt Hospital. June 12, 1904. Pain both sides; vomiting, belly full of pus; no adhesions. Blake's tube, washed out pus in all directions. McBurney incision; Weir extension; gastric lavage, with salts; peritoneum closed; external wound drained. Cured, no complications.

13.—John M., aged 55. Cutchogue, L. I. July 9, 1904. Fourth day; legs drawn up, distended and tender; very sick. McBurney incision; appendix perforated and gangrenous; removed. Free pus from pelvis to spleen; washed out rapidly; gastric lavage, with salts; peritoneum closed. Cured.

14.—Man, aged 42. Roosevelt Hospital. October 17, 1904. Perforated appendix; extensive purulent peritonitis. Appendix broken off; gut opened and sutured; free pus washed out with Blake tube from pelvis, left and right sides. Temperature 105°, pulse 180; bad condition; gastric lavage before and after operation; cigarette drain. Temperature fell to normal next day. Cured.

15.—Boy, aged 7. Roosevelt Hospital. October 18, 1904. Acute appendicitis. McBurney incision; saline irrigation, Blake's tube; pus pretty widely diffused, both sides; gastric lavage; peritoneum closed. Cured.

16.—Mary D., aged 14. September 12, 1904. Gangrenous perforative appendicitis; free pus throughout pelvis and lower abdomen. McBurney incision; appendix removed; irrigation with Blake's tube; gastric lavage, with salts; cigarette drain. Cured.

17.—Hood Wright Hospital, November 30, 1904. Perforative gangrenous appendicitis; spreading suppurative peritonitis. Free pus washed out of pelvis and left side; no limiting adhesions. McBurney incision; peritoneum closed; wound drained. Cured.

18.—Roosevelt Hospital, June 2, 1905. Perforated gangrenous appendix; free pus. McBurney incision; appendec-

tomy. Irrigation with Blake tube; gastric lavage, with salts; peritoneum closed. Cured.

19.—Boy, aged 12. Acute gangrenous appendicitis, perforation, free pus throughout lower abdomen, no adhesions, McBurney incision; appendectomy. Blake tube; gastric lavage; peritoneum closed. Cured.

20.—Female, aged 6. September 18, 1905. Acute perforative appendicitis; spreading purulent peritonitis. Appendectomy; McBurney incision. Free pus washed out of pelvis, left and right side; no limiting adhesions, cigarette drain to stump. Cured.

21.—Gangrenous appendicitis; spreading purulent peritonitis. November 27, 1905. Hood Wright Hospital. McBurney incision; appendectomy. Appendix torn off at stump and left; free pus throughout pelvis and lower abdomen; saline irrigation; drain to stump. Recovery.

22.—Male, aged 28. August 20, 1905. Roosevelt Hospital. Perforative appendicitis; spreading purulent peritonitis. Blake's tube; free pus washed out from pelvis and left side; lavage. McBurney incision; appendectomy; drain to stump. Cured.

23.—Female. September 15, 1903. Acute gangrenous appendicitis; perforation; advancing purulent peritonitis. McBurney incision; irrigation of peritoneum with Blake tube; appendix tied off; cigarette drain to site. Cured.

A REVIEW OF FIFTEEN HUNDRED OPERATIONS UPON THE GALL-BLADDER AND BILE PAS- SAGES WITH ESPECIAL REFERENCE TO THE MORTALITY.¹

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BETWEEN June 24, 1891, and May 1, 1906, Dr. Charles H. Mayo and myself have performed 1500 operations upon the gall-bladder and bile passages, of which number 96 per cent. were operated upon in St. Mary's Hospital, Rochester, Minnesota, and under nearly identical conditions.

One thousand of these cases were commented upon in a paper read before the Southern Surgical and Gynecological Association in December, 1904, and will be found in the Transactions of the society for that year.

The three most important considerations in the surgical treatment of any disease are, first, the mortality; second, the permanence of cure; third, the disability arising from the operation itself. The following investigation has been conducted with a view of elucidating the truth in regard to these essentials.

Mortality.—The first question to be considered concerns the operative mortality. In the 1500 operations there were 66 deaths, 4.43 per cent. In the first 1000 cases, previously referred to, the death rate was 5 per cent.; in the last 500, since that time, 3.2 per cent. This includes acute perforations with septic peritonitis and malignant disease. These statistics give, as an operative death, every case dying in the hospital without regard to the length of time thereafter. It includes death from accidental causes such as pulmonary embolus, myocarditis and a number

¹Read before the American Surgical Association, June 1, 1906.

of cases dying from chronic conditions occurring after one month, one from chronic nephritis as long as ten weeks after operation. This works an injustice to the statistics but eliminates the personal equation.

There were 845 cholecystostomies with a mortality of 2.13 per cent. In the last series of 500 there were 272 cholecystostomies with a mortality of 1.47 per cent. Two of these were sudden deaths from pulmonary embolism.

Looked at from the standpoint of mortality, cholecystostomy is the safest for the average case and must be considered the normal operation. As we had but one case of our own in the entire series of 1500 operations in which gall-stones reformed in the gall-bladder, this cannot be taken as a valid objection to leaving it *in situ*.

There are some conditions in which, after cholecystostomy, future trouble may be expected. First, in all those cases in which the cystic duct is obstructed by a stone, and the gall-bladder takes no part in the biliary circulation (contains no bile), other things being equal, it should be removed, as in this condition we have occasionally had to remove it secondarily for the relief of mucous fistula or colics due to obstructions, to drainage from kinking or stricture. Second, thick-walled gall-bladders which have become functionless, lead to a suspicion of malignant disease and should be excised. We have in this way several times unexpectedly removed what proved to be an early carcinoma of the gall-bladder. One such patient is now alive, more than three years.

In connection with common-duct surgery it is not wise to remove a functioning gall-bladder unless for direct indication. This is particularly true if cholangitis exists, as common-duct cases more often require a secondary operation than any other, and the gall-bladder not only affords easy drainage and enables cholecystenterostomy should there be future contraction and obstruction of the common duct, but it is also a safe guide to the deep ducts if future trouble should arise.

As to permanency of cure, our cholecystostomies have remained well with the exception of a few instances of bad selection in our early experience in which cholecystectomy would have been the better operation.

The operative disability after cholecystostomy was brief. A short incision with separation of the fibres of the rectus muscle rendered early union without hernia almost a certainty. By turning in the cut margins of the gall-bladder about the tube (Summers) in a similar manner to the Stamm-Kader gastrostomy, the bile discharge stopped promptly as, on removal of the tube at the end of the week, the peritoneal surfaces agglutinated. The average patient was up in twelve days and left the hospital within two weeks.

CHOLECYSTECTOMY.

There was a total of 319 cholecystectomies, with a mortality of 3.13 per cent. In the cholecystectomies in the last series of 500 cases the mortality was 1.62 per cent.

Cholecystectomy has an increasing field of usefulness, but its increase of mortality, which, although slight, is for one reason or another fairly certain, prevents it from replacing cholecystostomy. At the same time, where the circumstances permit of easy removal of the gall-bladder and the disease is confined entirely to this organ, it is the operation we most commonly perform even in cases in which cholecystostomy would answer the purpose. But if the patient is very obese and the gall-bladder has a broad attachment to the liver necessitating prolongation of the incision or increased manipulation, cholecystectomy is the more difficult and dangerous operation.

The permanence of cure after cholecystectomy is of course absolute when the disease is confined to the gall-bladder. In the majority of cases the incision was made nearly if not quite as short as for cholecystostomy. The period of convalescence was therefore about the same. In a few cases a longer incision was required, adding sev-

eral days to the disability. It was very rare that a patient was in the hospital more than fourteen days.

OPERATIONS UPON THE COMMON DUCT—207 CASES.

Operations upon the common duct so far as the mortality is concerned can be divided into four groups. This arrangement is more or less artificial, as some cases are hard to classify.

Group 1. One hundred and five cases with 3 deaths, 2.9 per cent., consisting of those patients in whom gall-stones were present in the common duct but without immediately active symptoms. Jaundice was moderate or not present. If it was present the obstruction was incomplete or intermittent and permitted of the escape of a certain amount of bile into the intestine. There was comparatively little infection of the ducts and with the exception of the presence of mucus, the bile was normal. The operation under such circumstances was simple and the convalescence short, the patients usually being able to leave the hospital within 15 days, and the cure has been permanent.

Group 2. Sixty-one cases with 10 deaths, 16 per cent. A series of cases in which there was active infection not only in the common duct but also involving the ducts of the liver. Stones were usually present. The patient not only had jaundice but suffered from Charcot's fever, (malarial type, irregular chills followed by a temperature from 103° to 107° , passing off in a few hours with sweating), pain intermittent and most marked just previous to the active symptoms; during the remissions a little bile passed the obstruction, relieving the liver. Among the older writers this was called "Remittent Bilious Fever." The added infection at once introduced an element of grave danger, not only from the operation itself but also through the production of certain complications which caused death in the first two months.

The patient also had an increased possibility of future

trouble as it was in this group that hepatic-duct stones were formed, of which we have seen seven examples. The infection and interference with drainage from a stone formed in the gall-bladder but which had passed into and lodged in the common duct furnished the necessary conditions for their formation. The cholangitis may subside and the stones reach a more or less quiescent state but after removing the calculi from the common duct others which have formed in the hepatic ducts may pass into the common duct, causing future trouble.

Coincident enlargements in the head of the pancreas or changes in the duct-wall may lead to secondary stone formation. Under such circumstances we have four times seen stones reform in the common duct after periods of from one to five years, requiring second operations. In two the gall-bladder had been removed at the primary operation, and the stones were too large to have come down from the hepatic-ducts. The possibility that these stones had as their nuclei hepatic-duct calculi cannot be denied in one case, but it does not seem possible that this was the fact in the other three. It was this group that was so often found associated with inflammatory diseases of the pancreas.

As a rule these patients were in the hospital from three to four weeks.

Group 3. Complete obstruction of the common duct; 29 cases and 10 deaths; 34 per cent. It is hardly necessary to call attention to the fact that formation of bile is only one of the functions of the liver, and that a patient may live for a great length of time with nearly if not quite complete obstruction of the common duct, the necessary amount of bile being absorbed by the blood and eliminated with the urine, perspiration, etc. In Group 1 we found the bile comparatively healthy, containing only a moderate amount of mucus. In Group 2 the bile was darker, containing a large amount of mucus and often showing colon bacillus on culture. The third group showed almost no bile in the ducts and the little present was thin and of a

dark spinach-green color, or in the worst cases a condition of complete acholia was manifest, the ducts being filled with a clear, colorless, mucoid secretion. The patient's general condition was extremely poor, pulse feeble and rapid, and in the long-standing cases there was sometimes œdema of the feet and free, bile-stained fluid in the peritoneal cavity. Albumen and casts in the urine and other evidences of extreme toxemia were usually manifested.

The operative mortality in this group during the period of complete obstruction was very high, 34 per cent. including deaths from early and late complications. Acute obstructions of this type when accompanied by evidences of infection were especially fatal, and as acute obstruction from stone is seldom permanent, it is often wise to wait for a period of remission before operation. It seldom happens that the duct will not dilate sufficiently in the early stages to permit of some relief of the symptoms, and this is the time to interfere, although later the inflammatory products in the duct-wall may contract down upon the stone, giving rise to permanent obstruction. In a few instances of complete obstruction which came on suddenly and which remained without temporary remission of symptoms, spontaneous cure by sloughing of the stone into the intestine took place. We have seen four examples. In each, after years of typical gall-stone symptoms, there was sudden and complete obstructive jaundice. In two there was a steady temperature and in all four there was a peculiar rigidity of the upper abdomen. After from six to twelve weeks of acute and severe symptoms the patient suddenly became relieved, the jaundice disappeared and a large gall-stone was found in the stool. Three of these patients were subjected to operation subsequently. In all one or more stones were found in the gall-bladder or in the adjacent liver border, the center of a cicatricial mass, but without communication with the bile tract, the common duct being densely adherent to the duodenum at the site of perforation.

The most common causes of death after operation in this group have been exhaustion from cholemia, with or without capillary hæmorrhage, and from sudden cessation of liver function.

All of the patients who recovered remained well. The hospital disability averaged a little over three weeks.

Group 4. This group concerned malignant disease; 12 cases; 4 deaths; $33\frac{1}{3}$ per cent. mortality. Cancer of or involving the common duct occurs in two forms. First the primary tumor of the common duct or papillæ, a small, hard, grayish-white mass, with a tendency to remain localized until a late stage. We have seen several examples and have had two primarily successful excisions, but no case which has lived beyond three years. Second, common-duct obstructions from carcinoma extending downward from the gall-bladder and cystic duct, or from cancer of the head of the pancreas. These cases are of course inoperable, and even an exploration proved fatal in several instances.

RELATION TO PANCREATITIS.

One of the most interesting problems in connection with surgery of the bile tract concerns coincident inflammations of the pancreas. In a total of 86 out of the 1500 cases the pancreas was involved to such an extent as to be noticeable on examination. Four of these cases were acute, of which two recovered and two died. Six were subacute, two of these having hæmorrhagic cysts; five recovered and one died; 9 cancer, 5 deaths; 67 had chronic pancreatitis; the evidences usually consisted of hard nodules most marked in the head of the pancreas and near to the common duct. Four cases, supposed to be common-duct obstruction from chronic pancreatitis alone, were shown by subsequent operation to have had an undiscovered stone in the ampulla. In a few cases the pancreatic disease apparently was not secondary to the bile tract.

That the acute forms have had a deleterious effect

upon the patient is unquestioned but I have been unable to separate the harm done by the chronic inflammations from the essential condition in the bile tract and I do not believe that unless it was obstructive it had a decided influence on the prognosis.

In summing up the causes of the 66 deaths 10 or 15 per cent. were accidental and could be eliminated. The largest number were due to cessation of liver function, usually the result of infections, microscopical examination showing destruction of the epithelial elements of the liver and often fatty degeneration. Next came exhaustion from blood changes due to chronic cholemia.

It was the mortality and complications of delay that placed the early operation for appendicitis on a sound surgical footing. To remove the disease while still in the appendix and before its rupture involved the abdominal cavity, was the logical conclusion.

The same reasons apply and with equal force to the early operation for gall-stone disease. Remove the disease while still in the gall-bladder by a mortality of from 1.47 per cent. (cholecystostomy) to 1.62 per cent. (cholecystectomy). This includes death from accidental causes, acute perforation and gross infections. Excluding these cases a mortality of less than 1 per cent. can be shown.

With the passage of the stone into the common duct we no longer have a localized disease but one fraught with grave dangers from liver infection and cholemia, and in this condition nearly one in seven of our cases came to operation, while one in twenty-five developed malignant disease of the gall-bladder, or bile tract, and in most of these cases gall-stones were present. In other words, one patient in six had allowed the favorable time to go by, although the very large majority had ample warning in the early and safe stage for operation.

SOLITARY ABSCESS OF THE LIVER.

A CONTRIBUTION TO THE PATHOLOGY, DIAGNOSIS, AND TREATMENT OF THIS DISEASE, BASED ON THE STUDY OF EIGHTEEN CASES.

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DURING the last decade the literature on abscess of the liver has grown to very large proportions. Especial attention has been paid to the so-called tropical abscess, and the symptoms and treatment of this affection have been carefully studied. There has been considerable confusion, however, in the meaning of the term "tropical abscess." Some writers have called every single abscess a tropical one, while others have limited the term to solitary abscesses which occurred in the tropics. It would be preferable, I think, to limit the term "tropical abscess" to those cases which occur in individuals who have lived or are living in the tropics and in whom there is a preceding history of amebic dysentery, although it might be allowable to include under the same head amebic abscesses of the liver which occurred in the temperate zones.

The term "tropical abscess" is also frequently used to distinguish the solitary from the multiple abscesses of the liver. This is not strictly correct, because not a small number of amebic abscesses are multiple. It is more correct to speak of single or solitary and of multiple abscesses of the liver, and to include under each of these heads the different varieties of abscesses classed according to their etiology. Under the head of single or solitary abscess of the liver would therefore be grouped the following:

1. The tropical abscess, following tropical dysentery.

This is associated with the presence of the ameba coli, and is said to follow rarely dysentery due to Shiga's bacillus (dysenteric abscess of Kartulis³²).

2. The traumatic abscess, either as a secondary infection of a hæmorrhage into the liver substance, or by direct infection from the surface of the body.

3. The pyæmic abscess, as a part of a systemic pyæmia. With this is not necessarily associated a bacteriemia (Libman).

4. Liver abscess secondary to a variety of abdominal affections. In this form the connection between the abscess and the primary disease is often in doubt. The infection is probably carried to the liver by the portal vein (idiopathic abscess of Kartulis).

During the last five years, 18 patients with solitary liver abscess were operated upon in the Second Surgical Service at Mt. Sinai Hospital.* In the majority of the patients the source of the infection could not be determined with certainty, although in a number of them there was a history of some preceding disease. These cases form the basis of the present paper.†

In 12 of the 18 patients there was a history of a preceding disease, viz.:

Trauma (gunshot wound) in one patient.

Cholelithiasis in one patient.

Chronic colitis in one patient.

Acute appendicitis in one patient.

Osteomyelitis of tibia in one patient.

Hemorrhoids in two patients.

Intermittent fever in two patients.

Occasional diarrhœa in three patients.

In the six other patients there had been no previous illness.

* Eight cases were operated upon by Dr. Lilienthal, four by Dr. J. Wiener, six by Dr. Eisberg.

† Two cases of suppurating gumma of the liver and one of suppurating echinococcus cyst are not included. Six cases of multiple abscesses of the liver are referred to later.

The history of the patient who had a solitary abscess of the liver after an attack of acute appendicitis follows:

Jacob E., 40 years of age, was admitted to the hospital on July 23, 1902. He had been operated on for an inguinal hernia six weeks before and for acute appendicitis three weeks before at another hospital. Very little of the history of the present illness could be obtained from the patient. He declared that for two weeks he had had chills and fever, with pain in the right hypochondrium.

Condition on admission, markedly emaciated. Examination of the chest reveals the following: In front there is dulness at the second right intercostal space, flatness from the fourth interspace to the base of the lung, with absence of voice and breathing. Posteriorly, there is flatness on percussion from the angle of the scapula to the base of the lung, with absent voice and breathing below the fifth interspace. Lower intercostal spaces on the right side very tender; area of marked tenderness below angle of scapula. Abdomen: unhealed wound in the right iliac region from which there is a moderate purulent discharge; percussion shows the liver to be enlarged upwards and downwards, lower border two finger-breadths below free costal margin; abdomen rigid, distended and tympanitic. Aspiration in ninth space post-axillary line gave thick non-odorous pus.

July 23, under ether anæsthesia, three inches of the ninth rib were resected (Dr. Elsberg), the pleural cavity, which contained clear serum, was opened and walled off with gauze as no sutures would hold, the diaphragm incised, and 54 ounces of pus evacuated. The subphrenic abscess was found to communicate with a large cavity in the right lobe of the liver; drainage.

Convalescence was uneventful; the temperature, which had been high, soon fell to the normal, and the patient was discharged cured twenty-four days after the operation.

Cultures made from the pus remained sterile; no amebæ could be found in the discharge from the wound.

While subphrenic abscesses and multiple abscesses of the liver are not so very rare after acute appendicitis (subphrenic abscess occurs in $2\frac{1}{2}$ per cent. of the patients (Elsberg¹):

multiple abscesses of the liver in 0.8 per cent. (Gerster²), solitary abscesses are very infrequent. Thus I have been able to find only 14 cases in medical literature although there have no doubt been a larger number (Cases of Herczel,³ Chvostek,⁴ Munro,⁵ Sheen,⁶ Koerte⁷ (2), Delageniere,⁸ Loison,⁹ Jones,¹⁰ Norton,¹¹ Sonnenburg,¹² Hildebrandt,¹³ Shoemaker,¹⁴ Besancon¹⁵). The patient of Delard,¹⁶ often referred to, probably had only a subphrenic abscess, and one of Koerte's⁷ patients had multiple abscesses.

Infection may reach the liver from the appendix or from another part of the abdominal cavity in one of several ways: (1) By direct extension, either through the bile-ducts or from abscesses in close proximity to the liver (subphrenic, perinephritic); (2) by the lymphatics; (3) through the arteries, as part of a systemic infection; (4) through the portal vein.

Koerte¹⁷ and Loison¹⁸ believe that hepatic suppuration often results from the direct extension of the suppurative process from the appendix region through the retroperitoneal cellular tissue. To judge from the cases of liver abscess reported in literature, this is not as frequent as these writers would lead us to believe. Loison states, in support of his view, that where there is a subphrenic abscess with a liver abscess it is impossible to say whether the liver abscess perforated the capsule of Glisson and became perihepatic or whether the latter perforated the capsule of the liver and caused the hepatic abscess. Munro voices his belief that a considerable number of liver abscesses are due to extension to the perihepatic region through the lymphatics, while on the other hand Jones¹⁹ denies that there are any lymphatics that run directly to the liver. The opinion of most writers seems to be that while infection of the liver through the lymphatics and from the perihepatic regions is possible, it is not of frequent occurrence.

In the majority of cases solitary abscess of the liver after appendicitis is due to bacteria or their products that are carried to the organ through the portal vein. Loison has pointed out that the organisms may travel up the vein and set up

the liver suppuration without leaving behind demonstrable changes in the vessel or its large branches.

Whether the abscess be a single one or multiple will depend not only upon the number of organisms that are carried to the liver, and their virulence, but also upon whether the infectious material is diffused over a very small area of liver substance in one lobe, or is spread over the greater part of one or of both lobes of the liver. In a certain number of cases the single abscess may be due to the confluence of several small abscesses in a lobule of the organ. Clark,²⁰ Windsor,²¹ Loison and others have shown that the solitary tropical abscess is often due to the merging of numerous smaller abscesses. Hence if the organisms that have entered the portal vein are carried to one or a few of the terminal branches of the vein, the abscess may be a solitary one, but if the septic matter is carried into a large number of branches multiple abscesses will ensue.

It is perfectly possible for a lesion in the gastro-intestinal tract which gave no symptoms to contribute sufficient infectious matter to cause in this way a single abscess of the liver. I believe that this is the explanation for many if not most of the single abscesses of the liver that are seen in the temperate zones, whose etiology has not been determined.

Location of the Abscess.—In 16 of our 18 cases, the abscess was located in the right lobe, and with one exception in the upper part of the right lobe. According to Rolleston,²² 80 per cent. are in this situation, while Jones states that only 6 per cent. occur in the left lobe. The more frequent affection of the right lobe is due to the fact that the branch of the portal vein that supplies the right lobe of the liver is larger, shorter, and more direct than the left branch.

The size of the abscess and the amount of pus it contains vary within wide limits, the largest quantities being found in the cases in which the abscess has secondarily invaded the subphrenic space.

The contents of the abscesses were of a yellow, brownish red or green color, and usually thick and of a mucoid con-

sistency. In four of our cases the pus had a foul odor,—three were cases with subphrenic abscess, and in the fourth case the odor was probably due to the presence of anerobic bacteria.

Our records are unfortunately incomplete as regards the organisms found in the pus, as no cultures were taken in some of the early cases. Of the ten cases in which examinations were made, the pus was sterile in six (60 per cent.), which corresponds pretty closely to the results of Giordano²³ who examined 72 cases and found the pus sterile in 58.4 per cent. The staphylococcus citreus was present once, streptococcus once, bac. coli once, anerobes once. A careful search for the amebæ coli was made in all of the cases but they were found only once.

The hepatic abscess had burst into the subphrenic region in six of the eighteen patients (30 per cent.). The pleural cavity contained clear serum in four patients, it was normal in three, it could not be examined in ten. Perforation of the diaphragm did not occur a single time.

Symptomatology.—The symptoms of solitary abscess of the liver may come on days, weeks or months after the primary disease. After having been well marked they may disappear for a time, the dormant stage of liver abscess. Several modes of onset are, however, characteristic.

I. *Acute Onset.*—(a) With or without a history of previous illness, the patient is suddenly attacked with pain in the lower part of the right or left chest, chills, fever, sweating, a dry cough, and marked prostration. The chills or chilly sensations are repeated daily, the pain persists, there is very rapid emaciation, the liver becomes enlarged and tender. (b) The patient is suddenly attacked with pain in the epigastrium and right or left hypochondrium, fever, cough, prostration. These symptoms increase in severity, and tenderness and muscular rigidity in the upper part of the abdomen soon appear. The liver becomes enlarged and tender, and the patient presents the picture of an acute abdominal infection. The abdominal type of onset.

II. *Subacute or Chronic Mode of Onset.*—(a) Without any previous disease or a number of years after some illness, the patients begin to have a dry cough, complain of a heavy feeling or slight pain in the lower part of the right or left chest, and begin to lose flesh and strength. After weeks or months, during part of which time the symptoms may be in abeyance, the temperature begins to rise and soon becomes of an intermittent type, chills or chilly sensations with sweats occur, and the liver becomes enlarged and tender; or (b) The mode of onset is similar to that of subphrenic abscess. The patients have an irregular fever as the first symptom, and then lose flesh and strength rapidly. These patients may show no local signs of their disease until the abscess invades the subphrenic region. Without any change in the temperature, respiration or pulse, some patients complain of continual slight pain in the right or left chest. The pain persists for weeks or months. Physical examination of the chest results negatively, and the patients never look very ill. Sooner or later the pain in the chest becomes more severe, there is enlargement of the liver, dulness, perihepatitis, and signs of fluid in the pleural cavity of the affected side. Then the presence of fluid under the diaphragm and perhaps in the pleural cavity is found by physical examination and the aspirating needle.

A detailed account of the various symptoms and signs that may be present in this affection would occupy too much space. Mention will only be made of some of the more important ones:

Pain, fever, enlargement of the liver, and emaciation are the characteristic symptoms of abscess of the liver, although one or more of these may be absent.

Acute pain may be absent entirely or may only appear late in the disease. It is not apt to occur as early as in subphrenic abscess, and is due in most cases to the perihepatitis which follows when the suppuration nears the surface of the liver. The pain is usually referred to the region of the liver and more especially to the lower part of the right or left chest

in front. The patients most often complain of pain along the free costal border or within an area situated between the mammary and posterior axillary lines. These localized areas of pain usually correspond to the points of greatest tenderness on pressure (Smits,²⁴ Koerte, Godlee,²⁵ etc.).

The tenderness along the free border of the ribs is usually most marked in the mammary line, but with marked abdominal rigidity it may be impossible to localize the point of maximum tenderness in this region. The other area of tenderness is obtained by pressure in the intercostal spaces between the eighth and the eleventh ribs on the right side, or below the ninth rib on the left side, somewhere between the anterior axillary and the scapular lines. Increase of the tenderness in this or in the infracostal region usually means that the abscess is approaching the upper or lower border of the liver or both. In some cases (two of our series) there was bulging in some of the lower intercostal spaces.

Pain in the shoulder was present in only four of the eighteen patients. Some writers, if not most of them, lay great stress on this symptom. Kramm²⁶ declares that it was present in 50 per cent. of his cases (tropical abscess), while it was said to have been almost the only symptom in a patient of Bramwell and Stiles.²⁷ On the other hand, pain in the shoulder was mentioned only twice in the 28 cases reported by Hart.²⁸

Enlargement of the liver may be absent if the abscess be a very small one, but there is usually more or less increase in the size of the organ. The liver was enlarged in all but one of our cases. It was enlarged both upwards and downwards, although it was sometimes difficult to map out the upper border of the organ with certainty in the presence of a subphrenic abscess or of fluid in the pleural cavity. The lower border of the liver was enlarged downwards in 17 of the 18 cases, and in all but two of these it was plainly palpable. Perthes,²⁹ speaking of the tropical abscess, says that even with an abscess of considerable size in the right lobe there may be no enlargement

downwards, while Kiefer,³⁰ from his large experience, declares that enlargement downwards is not the rule. The only explanation that I can offer for the difference between the abscesses we have observed and those described by the above-mentioned writers, is that in tropical abscess enlargement of the liver is not as frequent as in the abscesses here reported. The upper level of liver dulness is usually a curve, with its convexity upwards, which does not change with change in the patient's position. This convexity is, however, wanting when there is fluid in the pleural cavity.

Fever was present in every one of our cases. It usually ran an irregularly intermittent course, and in 9 of the 18 cases was accompanied by chills or chilly sensations and sweats.

A marked and rapid loss of flesh and strength was one of the chief complaints in 11 out of 16 patients. It was not unusual for the patients to have lost from ten to twenty pounds in one or two weeks.

Cough without or with slight expectoration was noted in 6 of the 18 patients (30 per cent.).

Jaundice occurred only twice among the patients, although most of the patients had a characteristic sallow, yellowish color. In this connection it might be mentioned that excepting in the two patients with jaundice above mentioned, we have never been able to find bile in the urine. Wendel,³¹ however, declares that he always found bile pigments in the urine in tropical abscess.

In every one of our cases in which a white blood-count was made, there was a leucocytosis—the smallest number of white cells in the cm. was 8100, and the largest, 34,500.

Diagnosis.—The greatest difficulties in diagnosis are encountered in the effort to differentiate between a single abscess and multiple abscesses, between liver and subphrenic abscess, or liver with subphrenic abscess. In many cases the differential diagnosis is impossible before the operation; a pleurisy with effusion or empyema and a subphrenic abscess may be recognized, while the underlying cause of the con-

dition—the hepatic abscess—remains unrecognized. The first point to determine is whether the affection is above or below the diaphragm or whether there is disease in both these regions—in other words, is there a pleural effusion alone, or a subphrenic or liver affection alone, or are both combined? The physical signs of pleurisy with effusion and of empyema need not be described here; mention will be made of only a few signs that are of diagnostic value. With a beginning pleural effusion there are more apt to be symptoms which point to an affection of the chest,—rapid respiration, cough, expectoration; the level of the dulness is generally concave upward, and the upper border of the dulness changes distinctly with a change in the position of the patient.

When there is a well-marked effusion under the diaphragm there are usually few or no thoracic symptoms; the upper level of the dulness is a straight line, or is convex upward, there is little change in the line of dulness with a change in the position of the patient. In pleural effusions the respiratory murmur is much diminished or absent below the level of the fluid, while in subphrenic or hepatic abscesses the murmur can generally be plainly heard below the level of the fluid. The heart is never appreciably pushed to the right. The greatest difficulties in diagnosis are met with in the cases in which a pleurisy with effusion is associated with a collection of pus underneath the diaphragm in the liver or in the subphrenic region. When the subphrenic abscess contains gas, the diagnosis of the two associated conditions is possible. In the upper part of the chest there are then the signs of pleuritic effusion, and below these the signs of an effusion containing gas. When the quantity of fluid in the pleural cavity is considerable, it may be impossible to make the diagnosis of a primary subphrenic abscess, or subphrenic secondary to liver abscess, or of primary liver abscess, except from a careful study of the patient's history and by means of the aspirating needle. If pus is withdrawn by aspiration through one of the lower intercostal spaces and clear fluid by aspiration higher up, the diagnosis of an association of two conditions is almost assured.

We have not found Litten's diaphragm phenomenon of much diagnostic significance, for it can be found to be present in many normal individuals.

According to Fuerbringer,³² the motions of an aspirating needle introduced into the abscess are pathognomonic. Fuerbringer claimed that during inspiration and expiration an exploring needle which had been introduced to below the diaphragm would move in the opposite direction to what it would do if it were in the pleural cavity. The movements of the diaphragm are often greatly impaired, especially when the diaphragmatic is adherent to the costal pleura and the costophrenic sinus obliterated. We have found this sign, however, of considerable value when it was present.

Localized œdema of the chest-wall, if present, is of importance, since it shows that the abscess is approaching the surface of the body.

The differential diagnosis between subphrenic abscess and abscess of the liver is very difficult and often impossible. In both affections the liver dulness is increased upwards and downwards and limited above by the diaphragm; in both is the lowermost level at which the respiratory sounds can be heard below the level of dulness; the clinical symptoms of hepatic abscess may be in all respects like those of subphrenic disease, or the latter is present secondary to a liver abscess.

As I have already shown, solitary abscess of the liver after appendicitis is rare as compared with subphrenic or multiple hepatic abscesses. Accompanying disease of the pleura (serous, sero-purulent or purulent effusion) is more rare in hepatic abscesses than in those in the subdiaphragmatic region. (The pleura were the seat of secondary inflammation in about 50 per cent. of the cases of subphrenic abscess collected by the writer.) For a number of other facts of diagnostic value for the differentiation between subphrenic and liver abscess the reader is referred to a paper on subphrenic abscess published a few years ago (*ANNALS*, December, 1901).

The differential diagnosis between solitary and multiple

abscesses of the liver is impossible in many if not most of the cases, although sometimes a careful consideration of the etiology and the course of the disease may result in the making of a correct diagnosis. Appendicular disease and affections of the gall-bladder and bile-ducts are more apt to be followed by multiple hepatic abscesses. The presence of fluctuation in the intercostal spaces or in the hypochondrium points rather to solitary abscess. Enlargement of the spleen occurs more often in multiple abscesses. Multiple abscesses of the liver are very apt to give marked symptoms early when the suppurating areas are still small, so that in a case where all of the symptoms and signs pointed to suppuration in the liver, negative results of repeated aspirations should make one think of the greater probability of multiple abscesses. Although there may be a well-founded suspicion that there are numerous abscesses, the patient should always (if the general condition permits it) be given the benefit of the doubt and operative interference be instituted as soon as pus has been found by the aspirating needle. Although, in a very few cases, a cure has followed the drainage of a number of abscesses of the liver, the presence of multiple abscesses is usually a fatal complication.* The danger from repeated aspirations of the liver, however, is not very great if one is prepared to follow at once with the operative interference.

There are several other conditions with which abscess of the liver may be confused, and which must be mentioned here. The differentiation of simple abscess from suppurating echinococcus cyst may be impossible until pus has been found with the aspirating needle and the characteristic hooklets have been found in it by the microscope. A previous history of liver

*In the cases of this kind, there were usually two or three large abscesses which were successively opened and drained. There is to the best of my knowledge not a single case on record where recovery has resulted in the presence of innumerable large and small abscesses scattered over both hepatic lobes, as are found in most cases of multiple abscesses of the liver.

tumor which has existed for many years before the onset of the present symptoms, may be of diagnostic value.

Metastatic carcinoma of the liver may cause enlargement and tenderness of the organ and is often accompanied by an irregular intermittent fever. During the past year there have been two patients on the Second Surgical Service at Mt. Sinai Hospital with metastatic carcinoma of the liver,—secondary to malignant disease of the rectum in the one case, and of the breast in the other. Both patients had enlarged and tender livers and for a number of weeks an irregular fever of between 100° and 104° . A history of preceding malignant disease in some other part of the body, or its demonstrable presence, a hard palpable tumor of the liver, cachexia, and the absence of a marked increase of polynuclear leucocytes in the blood, are of diagnostic value. The differential diagnosis can usually be made without recourse to the aspirating needle. The diagnosis of gumma can usually be made from the history. Other conditions that may have to be differentiated from abscess of the liver are malarial fever, intermittent hepatic fever due to infective cholangitis, abscess of the spleen (when the hepatic abscess is in the left lobe) and, rarely, large abscess of the kidney.

Prognosis.—The mortality after operations for solitary abscess of the liver is not as large as one would expect in view of the serious nature of the disease and the importance of the organ affected. Of the eighteen patients in our series five died (28 per cent.). Kieffer³³ believes that if the patients come to fairly early operation, 90 per cent. should recover.

Most operators have a mortality of between 20 per cent. and 50 per cent., although Smits³⁴ saved 18 out of 21 patients by early operation. Of 182 cases collected by Perutz³⁵ 44 died, a mortality of 24 per cent. From the cases we have seen we have gained the impression that the prognosis of amebic abscess of the liver occurring in temperate zones is not as good as the prognosis in single abscess associated with the presence of other organisms.

Treatment.—Whenever, after an acute abdominal affection, in which the local symptoms have been relieved, there are chills, intermittent fever, and rapid emaciation, it is important to examine the liver very carefully from day to day and to keep the possibility of a suppurative process in that organ in mind. As soon as the signs justify aspiration of the liver, this should be done, and when pus has been discovered, there should be no delay before operation is done. In rare cases, the symptoms and signs of liver suppuration may be so clear, and the rapid deterioration of the patient's condition so evident, that even when repeated aspirations have resulted negatively, an exploratory operation is justifiable. The following case of this nature is of sufficient interest to be reported in detail in this place:

Rebecca R., 32 years of age, was admitted to the Second Surgical Service of Mt. Sinai Hospital, on July 5, 1904. Twelve hours before, the patient had received a bullet-wound in the upper part of the right chest. It had been supposed by the physician who saw her at the time that the wound was only a superficial one. As her general condition was becoming steadily worse, she was brought to the hospital.

On admission, she was almost in collapse; the pulse was very small and rapid; the tongue dry and coated; just above the right breast in the fourth intercostal space was a small punctured wound with a large area of ecchymosis around it. The abdomen was generally distended and tympanitic; everywhere tender and rigid, but the rigidity and tenderness most marked in the epigastric and left hypochondriac regions. There was a normal area of liver dullness, but there was some movable dullness in the left flank.

The patient complained of severe cramp-like pain in the upper part of the abdomen but she could not localize it on one or the other side.

On the suspicion of an abdominal injury, she was at once taken to the operating-room for operation (Dr. Elsberg). Under ether anæsthesia the point of entrance was first carefully probed. The probe passed downwards and to the left to the lower part

of the sternum, where the bone was found to be bare. An incision was made at this point, and it was then found that the bullet must have passed downward into the abdominal cavity.

The abdomen was then opened by a median incision above the umbilicus. When the peritoneum was incised, a large quantity of dark blood escaped, together with a little gas. On the under-surface of the left lobe of the liver was a large irregular lacerated wound from which there was a continual oozing of dark blood. The wound was packed with gauze, and opposite it on the anterior wall of the stomach was a perforation of that organ about one cm. in diameter from which fluid stomach-content was escaping. The perforation was closed by a double layer of Lembert sutures. The lesser peritoneal sac was then opened by an incision along the greater curvature of the stomach. The lesser sac was clean, nor did careful examination of the posterior wall of the stomach reveal a wound in its wall. There was a large collection of blood around the lower part of the kidney.

The patient was, at this stage, in such poor condition, that further interference was considered contraindicated; the liver wound, the suture line on the anterior wall of the stomach and the region of the left kidney were drained with gauze, the abdominal cavity carefully sponged clean, and the greater part of the abdominal wound closed by layer sutures. The wounds in the chest-wall were drained. The patient was removed to her bed with a pulse of 180, but she improved rapidly under energetic stimulation.

From this time up to July 23 the patient steadily improved; the temperatures varied between normal and 101° , the pulse between 100 and 120. The wounds healed up slowly, with but little discharge.

July 23.—Severe chill followed by temperature of 104° and pulse of 140; few friction sounds over left base behind; leucocytes 17,000.

July 24.—Dulness from spine of scapula to base of left lung behind, with bronchial breathing, and almost absent voice and fremitus; aspiration of left chest negative.

July 26.—Rapid pulse has persisted with intermittent high temperatures; almost daily chills; physical signs over lower part of left chest the same as when last noted except that dulness now

extends to middle of scapula behind; clear fluid, withdrawn from left of chest with aspirating needle, was sterile on culture.

August 4.—The patient's condition has grown steadily worse, high temperatures and rapid pulse persist; the signs over the lower part of the left chest the same as when last noted; the patient is much emaciated; there are irregular chills with sweats; leucocytes 23,800. The left lobe of the liver is slightly enlarged downwards and is tender. The left lobe of the liver was aspirated almost daily but no pus could be found. X-ray showed the bullet between the ninth and tenth ribs behind, probably in the left subphrenic region.

August 6.—In spite of active stimulation, the patient is very weak to-day; she had a severe chill this morning, after which the pulse was almost imperceptible for several hours. The left lobe of the liver and left subphrenic region were aspirated in all directions, but the results were negative.

As the patient seemed almost moribund, and because of the probability of suppuration around the region of the bullet, it was determined to do an exploratory operation as a last resort. Under a light chloroform anæsthesia, three inches of the ninth rib on the left side were resected, the diaphragm exposed by pushing up the reflexion of the pleura, and the left lobe of the liver aspirated; the first aspiration withdrew thick grey pus. The diaphragm was then incised and the liver again aspirated. This time yellow pus was obtained. With the needle as a director the abscess of the liver was opened with a grooved director and dressing forceps and about two ounces of yellow pus evacuated. On account of the different character of the pus obtained at the first aspiration, the left subphrenic region was again aspirated, thick grey pus obtained, and a small subphrenic abscess opened and drained. By this time the patient was in very poor condition, so that no search could be made for the bullet. The abscesses were drained and the patient put upon energetic stimulation.

On the following day the patient's condition was much improved and the improvement thereafter was a slow but continued one. The temperature and pulse reached the normal after one week; she began to gain flesh and strength rapidly. Thirteen days after the operation the bullet was felt with a probe introduced into the sinus leading into the left subphrenic region, and after some difficulty was removed. It was of 38 calibre.

December 16.—The patient has gained 40 pounds in weight, all wounds are healed and on this day she was discharged from the hospital cured.

Cultures from the pus withdrawn from the abscess of the liver contained the streptococcus.

Remarks.—The interesting feature of this case, aside from the severe nature of the injuries and the recovery of the patient, was the fact that repeated aspirations were never able to find the pus in the left lobe of the liver and the left subphrenic region, although the physical signs, the presence of fluid in the left chest, and the probable location of the bullet by the X-ray in the left subphrenic region, pointed to an abscess in that location.

The exposure of a lobe of the liver and the adjoining subphrenic region can be made by one of two routes,—either by transpleural or infrapleural thoracotomy, or by an abdominal incision through the right or left rectus muscle. The abdominal operation must be retained only for those cases in which the symptoms and signs point to an abscess approaching the under surface of the right or left lobe of the liver, and in those in which there are mainly abdominal symptoms.

In the large majority of the cases, however, the abscess is located in the upper part of the liver and had best be approached through the wall of the chest. The technique of infrapleural or transpleural thoracotomy will not be described here, as the writer has described the typical operation in detail in a paper on subphrenic abscess (*ANNALS OF SURGERY*, December, 1901). I desire, however, to again lay stress upon one point in the technique of the transpleural operation which seems to me of great value, but which as yet has not been given the prominence it deserves.

In the transpleural operation (if the costo-phrenic sinus has not become obliterated by adhesions) the suture of the diaphragmatic to the costal pleura after the incision of the latter can often not be accomplished without the entrance of more or less of air into the pleural cavity. By means of upward

pressure against the liver, however, it is usually possible to so closely approximate the diaphragmatic to the costal pleura that little or no air can enter the pleural cavity when the pleura is incised and while the two layers of the pleura are being united by suture. The writer has found this method of great value in preventing an acute pneumothorax where there are no adhesions.

When the diaphragm has been incised, and there are no adhesions between it and the liver, the peritoneal cavity must be carefully walled off on all sides by gauze packings (which must be allowed to remain undisturbed for six to ten days after the operation). The liver is then aspirated and when the pus has been located, a grooved director is pushed into the abscess along the needle, the canal dilated with dressing forceps, and the abscess drained according to general surgical principles. If the abscess is deeply situated in the lobe of the liver, it may be advisable to use the actual cautery on account of the danger of hæmorrhage. In most instances the careful dilatation with the dressing forceps is all that is required.

When the abscess has burst into the subphrenic region, all that is necessary is to drain the subphrenic space after having made sure by digital exploration that the opening into the liver abscess is large enough to allow of free drainage. The liver has often to be drained separately with a large tube.

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THE TREATMENT OF GASTRIC AND DUODENAL ULCERS AND BENIGN OBSTRUCTIONS OF THE PYLORUS.¹

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THE question, how may we distinguish between the medical and surgical gastric ulcer, is of the greatest interest. We know that some ulcers cure themselves, for we find the scars at post-mortem examinations, where the patient has not given any history of gastric ulcer. Many ulcers give no symptoms, as is shown by the large number of perforations occurring in patients who have never had dyspepsia. One such case came to my knowledge. A friend of mine made the post-mortem examination and found a large perforated gastric ulcer on the anterior gastric wall. Shattuck says that "there are only two conditions occurring in gastric ulcer which demand operation: first, perforation; second, obstruction." We will all agree regarding the propriety of operating upon perforation cases. Here, if the perforation is due to an acute ulcer, and the opening can be closed, the wound sponged or irrigated, and a large-sized supra-pubic drain put in soon after the perforation occurs, a large percentage will recover, with the aid of the Fowler position. My own experience makes me feel that gastro-enterostomy in acute perforations is harmful, and the three cured cases who have had no return of their symptoms in over three years make me feel that it is unnecessary. In subacute or chronic perforation a gastro-enterostomy may in some cases be a wise procedure.

We can also all agree regarding the obstruction cases,

¹Read before the American Surgical Association June 1, 1906.

whether it be in the congenital obstruction of infants, or obstructions by bands or from inflammatory tumors accompanying chronic ulcer of the pylorus; these conditions are mechanical and demand mechanical relief. The congenital contraction presents a difficult problem, for, before the diagnosis is made, the infant is usually starved to the verge of exhaustion, and its normal resistance, which at best is poor, is further lessened by the disease.

Then, again, according to Scudder, one-third of these patients recover under proper diet. The spasm or contraction relaxes and the child outgrows the obstruction. In speaking of patients who recover without operation, one is apt to confuse true congenital hypertrophy of the pylorus with some similar condition which resembles it. As Mr. Edmund Cantley says, "I have seen several supposed cases get well without operation, but in no one of them did I agree with the diagnosis. On the other hand, I have no doubt that a mild degree of the condition can exist without proving fatal, for of this we have distinct evidence in the cases seen in older children. Yet of 15 cases which have come under my notice, all have been verified at operation or post-mortem examination. Only two of the last ten have been treated by purely medical measures, and both succumbed."

Scudder also makes the surprising statement that from the statistics of operated cases 50 per cent. recover. I have recently seen two of these little sufferers with Dr. Ramsey, of St. Paul. Both had a pylorus which was practically closed. One died from exhaustion following a gastro-enterostomy by Dr. Goodrich, of St. Paul. The other died without any operative relief, the child's condition when he reached the hospital being so bad as to make it certain that he would not stand any operation. Before death we could distinctly see the peristaltic waves or contraction, slowly passing from left to right across the child's emaciated abdomen. A post-mortem in each case showed a slightly-dilated stomach, with a pyloric opening contracted to the

size of a small probe by an extensive hypertrophy of the walls of the pylorus; on section showing a thick, white, fibrous band about one mm. in thickness and almost one-half inch in width.

It seems to me that there should be at least one other class added to this list,—*i. e.*, relapsing gastric ulcer, as suggested by Dr. Chas. Greene and others. How many relapses, would be an individual question. The nine complete and permanent cures facetiously mentioned by Haggard would certainly be an outside limit. That many of the chronic ulcers, with and without hæmorrhages, do recover after proper medical treatment, I know from my own observations. The statement that we often hear at the operating-table, that this patient has had three, four or more medical cures, is not sufficient; most medical treatment is a farce. The prescribing of pepsin, pancreatin, peptinzyne, papoid, and similar medicines, is useless and absurd. If there is any foundation in the theory that gastric and duodenal ulcer is due to hyperacidity, then the use of large doses of alkalis one-half hour after meals would be a rational line of treatment. In questionable cases when we suspect gastric erosion or a commencing ulcer, large doses of bicarbonate of soda and bismuth have seemed to me of considerable benefit, in temporarily, at least, relieving gastric pain. As a remedial agent the stomach-tube is of little value; it is of the greatest aid in diagnosis, and in a few middle-aged patients, with impaired digestions due to deformed or slightly crippled stomachs caused by the contractions of a healed gastric ulcer, the occasional use of the stomach-tube gives considerable relief (Graham).

Proper medical treatment consists in putting the patient to bed and taking away all food by the mouth from four to six or more days, or until all tenderness on pressure over the stomach has disappeared; supplying water and nourishment by the rectum. In 90 per cent. of these cases a week's starvation will prove sufficient; then we may commence with liquid foods and in two or three days we can

add baked potatoes, well-cooked rice and breakfast foods, spinach and the lighter vegetables. Most of these cases will have to be careful of their diet for months, but so will surgical cases, for that matter; very few gastro-enterostomy patients can be careless about their diet without suffering ill effects.

I have been surprised at the number of fairly permanent cures which have followed the above line of treatment. Some of them no doubt relapsed and have gone to some one else for an operation, but most of them I have been able to keep track of and know that they were quite well for long periods of time. The cases which were not relieved and who commenced vomiting again have usually proven to have a benign stricture of the pylorus, open chronic ulcer, or gastric adhesions. Inflammation of the gall-bladder may cause adhesions of the duodenum or pylorus, and these will produce painful digestion or true obstruction. Adhesions of the body of the stomach by the interference with the normal movements of the organs may produce great disability. One of my patients upon whom I had performed a posterior-no-loop-suture gastro-enterostomy was recently reoperated upon after an interval of one year, to find that the anterior wall of the stomach was densely adherent to the abdominal incision; the pylorus was open, and the gastro-enterostomy opening had not contracted. When she tried to get up and do even the lightest work she vomited as badly as before her operation; when she was put to bed she could take and retain light foods. The separation of this adhesion, one and one-half inches long by one inch wide, with scissors,—the suturing of the raw surface and the covering of the suture lines by a piece of omentum, relieved her of her stomach distress.

One of the greatest difficulties in dealing with these stomach cases is to distinguish between true chronic ulcer and the neurasthenic cases which they so closely resemble; careful watching for some period of time will often be neces-

sary to distinguish between the two. I am always suspicious of the case when the operator does not find any evidence of gastric ulcer at the time of operation. Of course there may be gastric erosion or fissure producing spasmodic closure of the pylorus, but such cases are medical and not surgical as a rule, and I speak from personal experience when I say that the patients are not improved by gastro-enterostomy. I have one such case of my own, and I have seen several operated upon by others, who were worse rather than better as a result of gastric surgery. Gastro-enterostomy has been and still is the operation most frequently done for all sorts of gastric diseases; the posterior-no-loop operation as assembled by Moynihan and last described by Mayo is by far the best operation so far proposed; it is sound in its mechanics, easy and safe in competent hands. The various operations for drainage of the stomach which have served their usefulness and have now been discarded are the anterior-long-loop, button and suture operation, which are now used in exceptional cancer cases. Mr. Patterson and Mr. Battle think that the popularity of the posterior operation is due to fashion, and that the anterior operation has advantages which will bring it back to favor. My observation is that the dragging of the heavy anterior loop causes the contraction of the opening and a relapse of the obstructive symptoms.

A few years ago we heard a great deal about the necessity of closing the pylorus after a gastro-enterostomy. This necessity has in a great part disappeared since the posterior operation has taken the place of the anterior. The Finney operation has a very limited field; the Roux operation, although effective, is not necessary if the loop is short enough, and the mortality is greater because there are two intestinal openings and suture lines instead of one. But as an operation gastro-enterostomy has been overworked. Dr. Rodman tells me that he found many reported cases of perforation and fatal hæmorrhage following gastro-enterostomy; many due no doubt in large part to faulty opera-

tions, where the anastomosis has been followed by kinking or twisting of the intestine and consequent water-logging of the duodenum. My experience in surgery of the stomach has not been great. Although I have seen a large number of questionable cases, I have avoided operating when possible because the permanent results until the past two years have not been satisfactory and the result of medical treatment has been fairly good. I have lately operated upon 30 cases, the last 15 without a death.

The operation of the future will undoubtedly be some form of resection. In many of the cases now treated by gastro-enterostomy, in chronic ulcer of the pylorus without obstruction, and in hour-glass stomach, resection is especially applicable.

VOLVULUS OF THE SMALL INTESTINE IN TYPHOID FEVER, SIMULATING PERFORATION.*

BY JOHN B. ROBERTS, M.D.,

OF PHILADELPHIA,

Surgeon to the Methodist and to the Jewish Hospitals.

A GIRL, aged 19 years, in the Polyclinic Hospital, under the care of Dr. David Riesman for typhoid fever, had been admitted on February 9th, and showed the usual symptoms of that disease.

At 9 P.M. on the 22d of the month she began to complain of abdominal pain of a severe character, which persisted throughout the night. On the next morning the patient was listless, with contracted pupils and parted lips; and had a temperature at 2 A.M. of 103.4° ; at 8 A.M. of 102.4° . The pulse had not varied much from what it was before the pain occurred, but her respiration was increased. The breathing was mostly abdominal in type. There was slight fulness in the lower right quadrant of the abdomen and extreme tenderness in that region, with marked rigidity and some dullness and impaired resonance. The pain was most marked at McBurney's point. At intervals the resistance lessened. There was no tenderness in the right flank posteriorly. The pulse was of good volume but dicrotic. The liver dullness was preserved and extended to the costal margins. The heart sounds had good tone and were normal. The tongue was dry and could not be readily protruded. At 11 o'clock in the morning of the 23d, tenderness and rigidity were more marked than at 10 o'clock.

When I saw her on the 23d at 11.30 A.M. the whole abdomen was rigid, but the rigidity was much more marked in the right iliac region. There had been no sudden drop in temperature, though in the preceding thirty-six hours the temperature had come down about three degrees and there had been a slight increase in pulse and respiration. At the time of the examination, however, the condition of pulse, respiration and temperature was about that which had existed prior to this gradual

*Read before the Philadelphia Academy of Surgery, April 2, 1906.

fall in the temperature. The patient was crying out at intervals from pain, and gave evidence of great pain when the skin over the right iliac region was even lightly touched. This occurred even if her attention were distracted from her abdomen, by asking her to put out her tongue. The general symptoms of perforation were not present, but the pain, tenderness and rigidity seemed to indicate some intra-abdominal lesion.

An incision, about three inches in length, was made over the ileocæcal region. No pus or serum was found in the abdomen. There was great difficulty in drawing up the cæcal portion of the ileum, which seemed to be imprisoned in the pelvis and was collapsed. The ileum, above the portion held in the pelvis, was moderately distended, freely movable, and easily delivered through the wound. The appendix was short and bound, throughout its whole length, to the cæcum by a web-like attachment, and pointed upwards. It was not swollen nor inflamed externally, and no concretion could be felt within it. The condition of the appendix seemed to me to be more like a congenital anomaly than a condition due to old inflammatory adhesions. There was no perforation in the appendix or cæcum. After a good deal of difficulty the lower portion of the ileum was pulled up from the pelvis and drawn out of the wound, when it became normally distended. There were no evidences of its having been held by adhesions. About two feet of the ileum, from the cæcum upward, were examined and no perforation found. There was no discoloration of the serosa to indicate the presence of internal ulceration. The gall-bladder was examined, but found normal to touch. It was moderately distended and contained no calculus. The incision was closed, and subsequently healed by first intention.

The patient's pain and the rigidity of the abdomen disappeared after the operation. She went through the remainder of the typhoid fever without abdominal symptoms other than such occasional pain as might be seen in ordinary cases. There was no later evidence that there had been an appendicitis to have been the cause of the pain and rigidity. The slight rigidity and pain, which were subsequently complained of, seemed to be very different from what was present at the time of the operation, and could readily be accounted for by the ordinary nervous condition of the patient. When convalescence seemed almost

complete, the patient had a relapse, with comparatively high temperature and an enlarged spleen. From this condition, she gradually recovered.

Consideration of this case seems to show that there was either a volvulus causing constriction of the lower portion of the ileum, or a mild appendicitis, due probably to a typhoid inflammation of the mucous membrane. Because of the critical condition of the patient from typhoid fever, the absence of definite symptoms of appendicitis and the possibility of the condition of the appendix being congenital, the appendix was not removed.

I have come to the conclusion that the symptoms were due to a sudden twist of the ileum, which was finally disentangled, when I turned the coils over and over, in my endeavor to bring the cæcal end of the small intestine up from the pelvis, in which it was imprisoned.

Dr. Riesman writes me that "taken all in all, I agree with you that volvulus or perhaps a localized spasm of the intestine was the cause of the girl's symptoms, which brought her to the operating-table."

The situation of the appendix was very like that shown in Figure 252 of Kelly and Hurden on *The Vermiform Appendix and Its Diseases*. It is labeled by those authors, "Embryonic Displacement of the Appendix." In this instance, which I am considering, the appendix was much shorter, but it pointed upwards and was similarly adherent to the cæcum.

Had I not found the bowel held down in the pelvis so firmly, I should have been driven to the conclusion that the symptoms were due to an attack of mild appendicitis, which promptly subsided, as not infrequently happens in that disease unassociated with typhoid fever. The woman states that she never had a similar attack of pain or other evidences of appendicitis. I have watched her carefully since operation, and have found no reason to believe that an appendicitis has been present. The operation

seemed to exert no influence on the course of the typhoid fever; except to relieve the abdominal pain and rigidity. Intestinal obstruction in typhoid fever from volvulus or other cause appears to be unusual. At all events its occurrence has not attracted the attention in literature that its importance demands. This may be due to the fact that many cases have been considered to be fatal perforations of the bowel. If no operation or necropsy was performed, the true condition would remain unrevealed.

Dr. Allan Eustis,¹ in a paper read March 11, 1905, before the Orleans Parish Medical Society, records two cases of fatal volvulus of the small intestine, occurring in typhoid fever. He believes that cases occur which are mistaken for perforation of, or hæmorrhage into, the bowel. In his cases the diagnosis was only made by autopsy, and it is probable that in both instances prompt operation would have saved life. The symptoms, according to Dr. Eustis, closely simulated those of perforation, excepting that the leucocytosis was not so high. He says that a localized paresis of the bowels favors the occurrence of volvulus, as does also absence of mesentery in the lower end of the intestine. He thinks that volvulus might occur in cases recovering from typhoid fever, on account of the localized peritonitis so often seen in this disease; and quotes Mayo Robson as mentioning the occasional occurrence of volvulus during colic from cholelithiasis.

DR. EUSTIS'S CASES.

CASE I.—A colored woman, aged 22 years, with typical symptoms of typhoid fever, for six and a-half weeks, was seized with violent abdominal pains, referred to the umbilical region, followed by violent and persistent vomiting. The morning temperature had been normal for 15 days, while the afternoon temperature reached 99° or 99.5°. The pain was accompanied by extreme collapse, subnormal temperature and imperceptible pulse. When seen by Dr. Eustis a few hours later her temperature was 97°, the skin cold and clammy, and the pulse imperceptible. She was vomiting almost incessantly and passing loose green

¹ New Orleans Medical and Surgical Journal 1904-1905, vol. lvii, p. 816.

stools with an offensive odor. The abdominal walls were rigid and palpation was extremely painful. There was very little tympanites. No mass could be felt through the abdominal walls, on account of their rigidity. The leucocytes numbered 15,000. She died within a few hours, notwithstanding the use of stimulants and external heat.

Post-mortem examination of the abdominal cavity disclosed a volvulus of the middle of the jejunum. The intestine here was intensely congested and almost gangrenous, and was matted down at the site of the volvulus. The mucous membrane from the ileocæcal valve to beyond the region of the volvulus showed ulcerations of the Peyer's patches. In some places the ulceration had almost extended to the serous coat of the intestine.

CASE II.—About ten days later a similar case was seen by him. It presented the following history: A colored girl, aged 15 years, was admitted to the Charity Hospital on July 22, 1903, in a delirious condition, which prevented the obtaining of a definite history. There was severe abdominal pain which persisted until death. The abdomen was moderately distended, tympanitic and extremely tender to pressure. The extreme prostration of the patient was overcome to some extent by stimulation until three days after admission, when she was seized with excruciating pain in the abdomen, accompanied by subnormal temperature. Vomiting occurred immediately and soon became stercoraceous. Diarrhœa with offensive stools succeeded the constipation which had been present for some days after admission. Cold, clammy skin, imperceptible pulse, and subnormal temperature occurred, and she died on July 27th without rallying from the initial symptoms of shock.

The intestines were found congested, and the solitary follicles and a few Peyer's patches were ulcerated. No perforation was found, but the intestines were matted together by recent adhesions. Four feet above the ileocæcal valve the adhesions formed a flexion about four inches in length producing an obstruction at this site, and there was distinct twisting of the involved intestine. Dr. Eustis believed it probable that both patients could have been saved by prompt surgical interference.

Duliscœuet reports a case of laparotomy for the treatment of intestinal perforation, occurring during convalescence from typhoid fever, in which four days later a second abdominal section was required because of twisting of an intestinal loop.¹

I have not been able to obtain the original article in time for incorporation in this paper. The double operation was followed by recovery of the patient.

J. Vincent reports a case of intestinal invagination

¹Anjou méd. Angers, 1899, vi., 193.

during convalescence from typhoid fever.¹ At the end of nearly seven weeks the man was suddenly seized with abdominal pain and vomiting. Up to that time the typhoid fever had shown nothing unusual, and was of moderate severity and devoid of special symptoms. The diarrhœa had disappeared, and the patient had been free from fever for about two weeks. The man showed depression and complained of a little dull and diffused abdominal pain, with occasional colicky attacks. Below the navel and especially above the pubes marked pain on pressure was present.

Vincent was uncertain whether intestinal obstruction or perforation existed. Necropsy disclosed an invagination of the jejunum about 30 centimetres below the duodenum, which completely obliterated the lumen. The invagination was downwards and about 5 to 6 centimetres of bowel were engaged. At a point below, a second invagination was found, but here the obliteration of the calibre was not complete. The typhoid lesions were cured and showed no trace of cicatricial contraction or ulceration.

In Dunglison's College and Clinical Record² is mentioned a case of chronic obstruction of the bowel occurring in a man who had had typhoid fever seven years previously. He suffered at the time of the fever with peritonitis and seemed to recover perfectly, but a year later he was seized with an attack of obstinate constipation. Dr. James C. Wilson, who showed the man at his clinic in Jefferson Medical College, stated that such attacks had continued to happen at intervals of eight or ten weeks. Vomiting would occur, and finally the throwing up of great quantities of food mixed with fæces relieved the symptoms until a similar attack took place a few weeks later. The voided matter was a large, irregular mass, showing the appearance of having come through a small aperture and then being

¹Archives de médecine et de pharmacie militaires, 1895, xxv., 400.

²Philadelphia, 1898, xix, 219.

coiled upon itself to form a large accumulation. Surgical operation was advised.

G. Harrison Young¹ reports an extensive chronic contraction of the ileum due to typhoid ulceration occurring two and a-half years before. It had caused no symptoms until sudden obstruction occurred after a jolt on horse-back. The patient died eighteen days later with symptoms suggestive of a second attack of typhoid fever. Examination showed great contraction of the lower twenty-two inches of the ileum, with enormous dilatation above this region. The stricture was due to two bands, in the sub-mucous tissue, believed to be due to old typhoid ulcerations. There were old cicatrices of the mucous membrane; and four recent ulcers in the ileum, one of which had perforated. There was also a perforation in the cæcum. The reporter did not believe the fatal ulcerations to be typhoid in origin.

Drs. R. H. Harte and A. P. C. Ashhurst mention² a case of peritonitis in typhoid fever due to intussusception.

August Hölscher, of Wiesbaden, in a study of the complications in 2000 cases of fatal typhoid fever examined in the Pathological Institute in Munich, mentions that ileus, or twisting of the intestines, was found in three cases.

It is probable that an extended search would show other reported cases of intestinal obstruction, happening in connection with typhoid fever and being responsible for its fatal termination. Enough has been said, however, to convince the thoughtful that acute abdominal crises in this fever should be sufficient warrant for prompt exploratory incision. The innocuousness of such operations skilfully performed, even in the course of this debilitating disease, has been fully established.

¹ Medical Press and Circular, December 1, 1886, p. 471.

² ANNALS OF SURGERY, January, 1904, p. 23.

MYOFIBROMA OF THE LARGE INTESTINE.¹

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TRUE Myofibroma, that is to say, tumors which may be classed strictly as, 1, Leiomyomata; or 2, Rhabdomyomata of the large intestine, are practically unknown. Tumors involving the large intestine are usually fibromyomata, and the muscular elements they contain put them, with very rare exceptions, under the class Leiomyofibromata. These tumors are found most frequently about the rectum. A few cases on record have affected the colon and cæcum. The sigmoid flexure is very rarely involved.

The literature of myomata of the large intestine is very meager. E. Lexer, in *Verhand d. Deutsch Gesellsch. f. Chirurg.*, XXI, Part 2, pp. 440-446, gives the best summary of cases and discussion of the subject I have seen. He divides myomata of the large intestine into three groups, as follows:

(Group *a*.) Tumors which develop in the lumen of the gut. These tumors appear as roundish or polyp-like tumors; they are pedunculated, covered by mucous membrane, and are of rather a hard consistency. These are found usually in the rectum; microscopically they are fibromyomata. They may usually be removed by way of the anus by ligating and cutting through the pedicle. Lexer collected six cases of this variety, one reported each by Tedenal, Carlein and Heurtaux, two reported by König, and one by Caro.

(Group *b*.) Tumors which develop from the outside walls of the intestine, also more or less pedunculated; these impinge on the lumen of the intestine by pressure on account of their bulk; they involve usually the upper part

¹ Read before the American Surgical Association, May 30, 1906.

of the rectum or lower sigmoid. They must be removed by a laparotomy. Three cases are given under this group, namely, one each by Senn, Westermarck and Pfannensteil, the latter a double tumor.

(Group c.) Tumors which develop from the rear of the rectum, which by their growth fill up the cavity of the pelvis. They must be removed by sacral exsections or parasacral incisions. Three (3) cases are given under this group, one each by Berg, McCosh and Lexer.

The tumors of the last two groups are difficult to diagnose and are usually mistaken for other growths.

Lexer credits Longuet ("Des tumeurs conjonctions benign du rectum," *Le Progres Medical*, 1898, S. 137) with the collection of six of these cases.

I have been able to collect a few other cases, reference to which will be found in the short bibliographical list appended to this paper.

These tumors are the true fibromyomata of the large intestine.

I have a case to relate which suggests the possibility of a fourth group, namely, inflammatory or hyperplastic myofibromata. While there can be no doubt that the tumor in my case was of inflammatory origin, it was a distinct circumscribed ovoid mass, uniform in development, symmetrical in shape, which produced by its growth and mass almost complete obstruction at its immediate location, and notably it was made up chiefly of muscular tissue, with fibrous deposits, and it was pronounced histologically a myofibroma. It was more than a hyperplasia. It was a tumor made up of mixed elements, but chiefly of myofibromatous tissues.

Obstructions of the large intestine by strictures which result from chronic inflammations not involving the mucous membrane are very rare, but there are several cases on record of this kind. I will mention these later on.

Willmanns (R.) in *Beiträge zur klinische Chirurgie*, 1905, XLVI, 221-232, published under the title "Ein Fall

von Darmstenose infolge chronisch entzündlicher Verdickung des Ileocæcal Klappe," a case of obstruction of the bowels on account of the thickening of the muscular layers at the ileocæcal valve. Rotter, whom I will quote presently, gives some cases of inflammatory strictures which involved the sigmoid. None of these cases, however, presented a distinct circumscribed mass which without involving the mucous membrane produced by its bulk and pressure nearly a complete obstruction of the bowels. My case seems, therefore, unique. The history of the case is as follows:

T. M. D., aged 62; married, American. Entered St. Luke's Hospital, November 10, 1904. His family history was unimportant. He had never been a robust man, but he had enjoyed fairly good health up to about seven years before this time. At this period,—namely, seven years before he entered the hospital,—he consulted me about some dyspeptic symptoms and obstinate constipation. Notwithstanding treatment his constipation became worse, and a tumor gradually developed in the left iliac region. This tumor was quite hard, slightly nodular, and seemed to be located between the sigmoid flexure and the left sacro-iliac synchondrosis; it was firmly fixed, not particularly sensitive to the touch, and seemed to be connected to the pelvic fascia rather than to the gut. Gradually fever and almost complete obstruction of the bowels developed. The tumor steadily increased in size without losing any of its hardness. Dr. John Da Costa, Sr., of Philadelphia, saw the case twice in consultation and concurred in the diagnosis of a hard tumor of the pelvis which caused occlusion of the intestine by pressure upon the walls. I thought the tumor was a sarcoma which originated from the neighborhood of the left sacro-iliac synchondrosis. Dr. Da Costa expressed no opinion as to the nature of the tumor, but agreed with me that it did not involve the lumen of the gut except by juxtaposition. Septicæmic symptoms finally came on, then a very large swelling which involved nearly the whole left iliac region developed; this soon became cystic and adhered to the anterior abdominal walls. These evident manifestations of pus were speedily met by an

incision below and about 5 cm. within the ant. iliac spine. A large quantity of most offensive pus and blood was discharged. A drain was introduced and daily washings-out were instituted. Improvement began at once, and the patient made a slow but apparently complete recovery, first from the septicæmia, then from the intestinal obstruction, and finally the *tumor entirely disappeared*. That the tumor did disappear there can be no possible doubt. I examined the patient repeatedly, Dr. A. T. Cabot, of Boston, examined him twice, once in the fall of 1897 (six months after the operation); he then thought he felt "a little hard mass about as big as the last joint of my thumb or possibly a little longer." At this time there were still some obstructive symptoms remaining, viz., irregular and sometimes difficult defecation, occasionally colicky pain, and a very decided tendency to bloating and intestinal distention. Dr. Shattuck, to whom Dr. Cabot sent him at this time, could not feel any tumor or thickening. Four months later there was absolutely no sign of a tumor and no symptoms of obstruction. Dr. Cabot examined him again and reported: "I examined him carefully, and certainly the little mass I felt at his last visit in October is no longer to be plainly felt. There is a little sense of resistance just inside of your incision, but no more, I think, than such an abscess as he had might have left. There is certainly nothing there now suggesting a new growth. The perfectly easy action of his bowels makes me think that there can be no real obstruction there at present." This states and sums up my own findings and opinion of his condition exactly.

For nearly six years he was in good condition and free from any tumor or symptoms of obstruction. Then gradually he began to have a return of his distention, and he had frequent belching, poor digestion, colicky pains, and increasing difficulty in having a bowel movement. This went on for about six months. During this time one could feel a slowly-growing tumor, which was oval in shape, quite movable, not sensitive to the touch, and which was located in the region of the sigmoid in the left iliac region. The feel was very different from, and its location was higher than, the first tumor, seven years before, and while the first tumor was quite fixed and undoubtedly to the outside of the rectum, this one was decidedly movable and seemed to be *a part of the sigmoid*. He had now a left inguinal hernia and a

very large ring which made it almost impossible to retain the hernia by a truss. Obstruction symptoms became progressively worse, until finally he had almost complete obstruction of the bowels. It was evidently necessary to resort to an operation for relief. He entered St. Luke's Hospital nearly seven years after his former "attack" and operation, and asked that the tumor be removed.

Condition When Admitted.—A rather pale, stout, flabby man of medium height. His lungs are normal, the heart action is rather weak, his heart muscle is decidedly below par, but the valves are good and the action of the heart is regular, the organ itself is enlarged, liver and spleen normal. The urine is normal. The abdomen is decidedly distended and he belches frequently. General tympany except over the course of the colon; the lower colon is quite dull. In the left iliac region there is a large oval mass just inside and a little below the anterior superior spine. This mass is hard, generally oval in outline, with its long axis directed obliquely downward and inward; it is movable and not tender to the touch. No enlarged lymphatic glands can be felt. The patient states that it is with the greatest difficulty that he can have an evacuation from his bowels; enemas are necessary and he finds he can receive and retain very little water without it causing great pain. He passes some mucus with his stools, but no blood nor pus. He has increasing difficulty in passing his urine. There is a large left inguinal hernia which is not completely reducible. Examination by rectum reveals nothing except that the rectum is empty and that it is ballooned.

The operation was done the day after his admission to the hospital. Ether anæsthesia was used; a left longitudinal incision along the outer border of the left rectus abdominis muscle was selected. As was supposed, the tumor involved the sigmoid flexure. It was found to be an enlargement which felt solid and which seemed to involve the whole periphery of the colon equably; it was about 14 cm. long and about 6 cm. thick (diameter). It was adherent to the fundus of the bladder, and the coil of intestines which escaped through the left inguinal canal was also adherent to it, and the mesentery of this intestine was very extensively and firmly united to it. After great difficulty and with a very tedious dissection the adhesions were finally severed and the tumor freed. It was then removed and the

severed ends of the colon united by an end-to-end anastomosis. The sac of the inguinal hernia was also dissected out and a modified Bassini operation was done. The operation was a tedious and a long one, but the patient stood it very well. The day after the operation the patient's abdomen was somewhat distended, but he passed considerable flatus during the day. The second night he began to vomit and notwithstanding several washings out of the stomach he continued to vomit. Distention of the abdomen was so considerable that I ventured to pass a rubber tube and wash out the colon above the anastomosis. This did not, and nothing else that I could do, relieve the complete paralysis and stasis of the bowels; on the fourth day after operation his heart showed such unmistakable signs of weakening that I determined to open his intestine. Accordingly, under Schleich's local anæsthetic I made an incision in the left abdomen and drew out a knuckle of the colon just below the splenic flexure, fixed it to the skin and opened it. This little operation was, however, too much for the patient; he fell into a coma from which he did not recover for several hours. He died the fifth night after his operation. Myocardial weakness was exhibited in the usual classic symptoms the last day of his life.

I believe if I had done, as I intended to do, an ileocolostomy after removing the tumor, the patient might have lived. When I mentioned this possibility to him before the operation he begged so urgently that I should not do this that I was moved against my better judgment to make an immediate anastomosis. After such long and almost complete damming up of the whole intestinal tract, immediate and complete drainage would certainly have been best. The pathologist's report will give a complete description of the tumor, but I would like to emphasize the fact that when examined immediately after the operation the tumor mass presented the gross appearance of the colon, which had been almost entirely occluded by enormous thickening of its muscular walls; the lumen had been reduced to a canal that would scarcely admit my little finger (about 0.5 cm.). *There was absolutely no ulceration*



FIG. 1.—Myofibroma of sigmoid.

of the mucous membrane, and this layer appeared quite normal. No cicatrix nor bands of fibrous tissue were found macroscopically in any of the coats. Only one large lymphatic gland was found in the mesocolon opposite the tumor.

The especially interesting and important point is that the tumor was formed *in the walls* of the intestines, and that the stricture of the sigmoid was produced by, and exactly at the site, and for nearly the whole extent of the growth or thickening of the muscular tunic of the intestine. *The stricture was not below the growth, but within and produced by the growth.*

Report of the Pathologist, Dr. A. L. Kotz.—The specimen (Fig. 1) was a spindle-shaped tumor involving the entire circumference of the intestine, 14 cm. in length and 5.5 cm. in its thickest diameter. The lumen of the intestine at its most constricted portion was less than 0.5 cm. in diameter. On section it was found to be a hyperplasia of the various layers of the intestinal wall, with numerous small granular foci in the outer tunic.

The mucosa was intact throughout the entire extent, but very much puckered, and with the submucosa, which was also in excess, formed a thickness of 0.7 cm. This surplus of membrane evidently resulted from contraction of the longitudinal muscular and serous layers, as like conditions were also found in the circular muscular layer and in the mesosigmoid.

The muscularis formed the greater bulk of the tumor. The circular layer was 1 cm. in thickness. The bundles of fibres were broad, flat and compact; this also was due to a crowding of this layer from shortening of the intestine.

The longitudinal layer, about 0.5 cm. in thickness, was very compact and closely united with the circular layer. Its outer surface was in some places more or less blended with the fibrous tunic of the serosa, and in others separated from it by granular foci. These deposits also penetrated into the muscular substance.

The serous tunic including the subserous connective tissue formed a dense, uneven, pigmented layer of variable thickness, and contained numerous granular foci. It formed a tense covering of the tumor, as was apparent from the extreme aversion of the intestine in the longitudinal section. This, too, explains the crowding of the other layers and mesosigmoid. That the active etiological factor was here located is evident, as will also be seen by the histological findings.

The mesosigmoid contained a large amount of connective tissue with most of its fibres running visceroparietally. From its appearance this was more of an accumulation than actual hyperplasia, and evidently resulted from contraction of the intestine. The mesenteric glands found were few in number and slightly enlarged.

The histological changes, like the gross findings, were mostly confined to the fibrous tunic of the serosa and external muscular layer. This was found the seat of a chronic tubercular inflammation extending over the entire tumor, as was evidenced by microscopic findings, as follows: A high degree of capillary engorgement, small cell infiltration, hyperplasia and pigmentation; granular foci, consisting of lymphoid, epitheloid and giant cells; in the latter tubercle bacilli were demonstrated; and areas of cicatricial tissue due to the healing of old tubercles. The connective tissue throughout the entire tumor was hyperplastic, more marked in the outer than inner layers. The muscular tissue predominated, it was pale, the nuclei elongated and stained poorly. The epithelium was well preserved. The solitary and mesenteric glands both were slightly infiltrated.

Summarizing from the gross and microscopic finding, we have a tumor of the intestine in which the predominating elements are muscular and fibrous tissue respectively; a tumor resulting from an inflammatory hyperplasia, with contraction of the longitudinal muscular and serous layers and thereby causing circumstantial hypertrophy by crowding of muscular elements; a chronic tubercular process in the external layers of the intestine as the etiological factor.

In accordance with the predominating component elements of the tumor, I believe we are justified in considering it a myofibroma.

The etiology of the patient's condition, and the pathologic explanation of the development of a myofibroma of the sigmoid, are to me exceedingly interesting, and difficult to meet. The nature of the first tumor, which appeared about seven years before the patient entered the hospital, and which completely disappeared after the abscess, which developed, had been evacuated, drained and finally healed, is very doubtful. It certainly felt like a solid and quite hard tumor, it was to the outer side of the upper rectum and seemed fixed to the side of the pelvis, it could be felt by a finger passed into the rectum and was below the site of the second tumor. The tumor *entirely disappeared* after profuse suppuration and marked septicæmia of the patient.

Several explanations occur to me. The first one is that it might have been a left-sided appendiceal abscess; the findings at the second operation would hardly bear this out, however. A second suggestion is that the tumor really was a new growth from the side of the bony pelvis,

which by pressure produced a closure of the lumen of the rectum high up; infiltration of the cellular tissue about the rectum resulted, infection from the rectum or colon followed, suppuration and the abscess came as the natural sequence. Relief of the abscess with subsequent resolution affected the tumor as well as the other tissues in the immediate neighborhood, and gradual absorption may have occurred in the tumor. Mixed toxins must have been present in abundance, a sort of Coley's fluid may have been developed, and a cure of the original tumor resulted. This view would afford a partial explanation of some of the extraordinary hypertrophy of the muscular layers, which finally grew to such remarkable thickness that a tumor was formed and the intestine was again occluded. The persistent effort of the colon to relieve itself of the burden of accumulated fæces would naturally result in a thickening of the muscles, and if long continued very marked hypertrophy might occur. The entire absence of any papillomatous or other growth anywhere in the colon or rectum, and the fact that the mucous membrane of the intestine was quite healthy, indicate that the inflammation did not primarily come from any disease of the lining of the intestine. I searched in vain for extensive matting or adhesions in the pelvis or about the bladder, to prove that the abscess which formed nearly seven years before was the result of an appendicitis or other intestinal rupture. True the bladder *was* adherent for a considerable area, but there were no strong fibrous adhesions to the walls of the pelvis and to the lower coils of the small intestines and to the omentum, as there naturally would have been if the old abscess had been an appendiceal one. The adhesions were confined to the area between the sigmoid, the pelvic walls, the bladder, and the coil of intestine and its mesentery, which passed obliquely across the anterior surface of the tumor.

Dr. Kotz says positively there were tubercular bacilli found in the necrotic spaces in the muscles. This finding

may furnish the key to the whole matter. If the former tumor had been a tubercular infection of the mesosigmoidal lymph-nodes, which finally suppurated and were discharged, it is conceivable that an invasion of the coat most affected in trying to overcome the obstruction of the bowels should follow secondarily, and remain the nidus of a persistent chronic inflammation, and hypertrophy of the muscular tissues would continue as a result of increased work resulting from the torsion or deviation, or possibly the adhesions of the sigmoid, already mentioned. That this hypertrophy should be of such extraordinary thickness that it finally formed a *tumor* large enough itself to produce obstruction is certainly remarkable and as far as I know it is unique.

Prof. J. Rotter in Arch. f. klinisch. Chirurg., Vol. 61, p. 866, discusses non-malignant strictures of the sigmoid. He calls especial attention to the fact that the upper part of the rectum and the sigmoid are very rarely strictured by inflammations. It is very rare indeed for a tubercular stricture to affect the sigmoid or colon, and when this *does* occur the origin of the disease is in the mucous membrane. All of the diseases which produce non-malignant strictures, —namely, gonorrhœa, syphilis, tuberculosis and dysentery,—have the common starting place, viz., mucous membrane.

Rotter says there is scarcely anything in surgical or anatomical literature concerning cases of stricture of the sigmoid resulting from inflammations which do not originate in the mucous membrane, and such cases are exceedingly rare. He credits Graser with the honor of having published the first case of this kind in Münchener Med. Wochenschrift, 1899, No. 22, and in Langenbech's Arch. für klin. Chirurgie, Bd. 59, 3. Rotter in this article publishes three cases of his own, all of them suppurative cases, and they produced strictures by bendings of the lumen of the sigmoid from adhesions and fibrous contractions. In one of his cases there was a one-sided thickening of the intestinal wall *above the stricture*, the stricture itself having

been produced by a flexion of the sigmoid and fibrous narrowing. In all these cases the mucous membrane did show signs of involvement, but Rotter argues that this involvement was only secondary through suppuration and sinuses.

Graser's explanation of these strictures based upon some very interesting experiments, quoted by Rotter in this article, is as follows: The blood supply to the sigmoid is carried by devious channels from the mesentery to the mucous membrane. They are so arranged that they serve as blood-storers,—small reservoirs of blood,—which communicate with small spaces (Lücker) in the mucous membrane. In certain conditions of blood pressure, notably in condition of chronic heart disease, which lessen the force of the blood, these spaces become partially empty and into these gravitate material from the lumen of the intestine. These spaces gradually elongate and enlarge from pressure until diverticula form; infection extends to the mesentery and there an abscess develops; the pressure of this abscess in the mesentery will cause obstruction more or less, according to the size of the abscess. If the abscess be safely evacuated by sinuses into the lumen of the gut, or by incision externally, the contraction of the fibrous tissue which results will cause a thickening in the mesentery and a deviation or bending of the sigmoid, its lumen may be markedly narrowed and finally a stricture will result.

Graser's theory fits the history and the apparent condition of my case in some respects very closely. Graser, Rotter, nor any other writer of whom I know anything has ever reported a case of a genuine inflammatory, or hyperplastic, myofibroma which involved the whole circumference of the sigmoid, and which on account of its bulk produced almost complete and symmetrical obstruction of the gut. This case seems, as I said before, unique. It was a genuine and symmetrical tumor, and while of inflammatory origin was histologically a myofibroma.

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THE OPERATIVE TREATMENT OF CANCER OF THE LARGE INTESTINE, CAUSING DANGEROUS INTESTINAL OBSTRUCTION.*

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WHEN one reviews the conditions of the large intestine requiring surgical treatment, the subject of intestinal obstruction is at once presented for consideration. These cases are frequently in elderly patients due to occlusion of the lumen of the intestine by carcinomatous growths. The lesion is situated in the intestinal wall and presents in its earlier stages almost no characteristics which can be detected by physical examination. It is usually found in the descending colon and is adenocarcinomatous in character. The symptoms may be indefinite for a long time, and not until the occlusion is marked does the spasmodic pain, vomiting, distention, etc., present the clinical picture resulting from marked interference with fecal circulation. These cases, since they are usually not seen by the surgeon till he is called to relieve the obstruction, present the following complications:

1. The difficulty in determining the cause of the patient's condition.
2. The difficulty of determining its location.
3. The danger to the patient of shock from the prolonged difficult exploration often necessary to ascertain accurately the above-mentioned facts, and from the operative procedure required to radically relieve him.

For purposes of illustration I report the following

* Read before the American Surgical Association, May 30, 1906.

clinical history of a case in which the colon was resected to relieve dangerous intestinal obstruction due to cancer.

The patient was a single man, forty-eight years of age, of Scotch parentage, and a laborer by occupation, who was admitted to my service at the Boston City Hospital on February 15, 1904. He gave the following history: That he had been well till fifteen years ago. He then suffered an attack similar to the present one, but less severe in character. For the last ten to twelve years there has been habitual constipation, necessitating the more or less constant use of cathartics. In 1894 a right scrotal hydrocele was noticed, which has been tapped each year since. It is now of large size. In 1902 he had an attack of pleurisy, after recovering from which he was apparently well till February 10, 1904, on which date the attack began which forced him to seek relief. This attack was characterized by abdominal pain which at intervals became quite severely acute or "cramp-like," and was referred to the subumbilical region. For three days (February 7-10) previous to this attack there had been no dejection. On February 11th enemata were followed by a dejection. From February 11th to the 15th the bowels moved once daily, the dejections being small in amount, and consisting of hard, fecal masses, but no mucus or blood. There was slight nausea, and vomiting after food even in small amounts. The pain after the first of the attack almost disappeared. There was anorexia and loss of strength. On February 15th he entered the hospital.

When examined he seemed to be in a fairly good general condition. His expression was somewhat anxious. Tongue was covered with a white, creamy coat. Glands not especially enlarged. Heart and lungs negative. There was a very large scrotal hydrocele. Temperature was 100.5; pulse 80. In the right side of the abdomen over the kidney-shaped area shown in Figure 1, there was fullness and a marked tympanitic resonance. Abdomen elsewhere was only moderately distended.

During the 16th, 17th and 18th of February, under treatment, the subjective symptoms were relieved. Temperature 98 to 99.5°. Pulse, 80, 72, 85, 100. The patient was quite comfortable. He occasionally vomited after taking liquid food. High enemata (twice a day) produced slight results. The swell-

ing and tympanitis increased slowly, as shown in Fig. II. On February 19th vomiting began to occur every few hours, becoming fecal in odor and character. The abdomen rapidly distended and became tympanitic. The condition of the right side changed as shown in Fig. III. Temperature 99.5° , pulse 100-102. This rapid change for the worse required radical treatment, but the

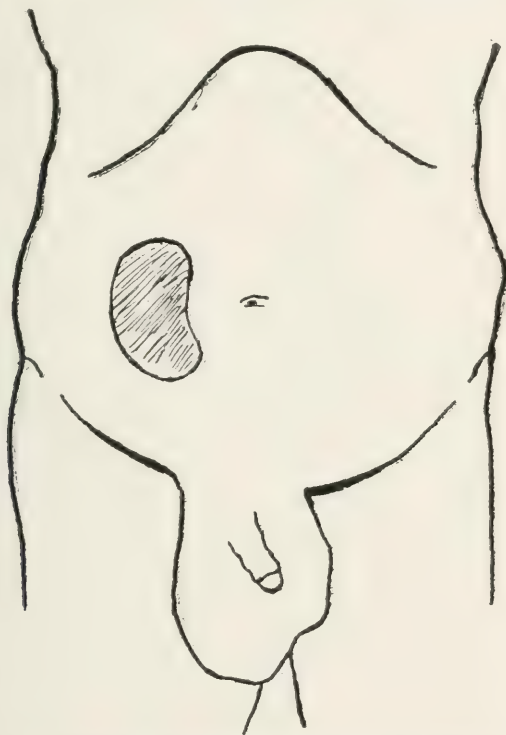


FIG. 1.—Shaded kidney-shaped area shows site of special intra-abdominal fulness and tympanitic resonance.

consent of the patient for operation was not obtained till 6 P.M. on the 20th. An attempt was then made to find the obstruction and relieve it. The patient's general condition was at that time rather poor. There were signs of exhaustion. Temperature 99.6° ; pulse 100-105. Face anxious. Symptoms of the 19th still existed. The abdomen was well distended. On the right the conditions shown in Fig. III were present. The apparent

tumor seemed fully four inches in diameter and extended from the costal border to the iliac region.

Under ether an incision in the median line extending from the navel towards the pubes opened the abdomen. The tensely distended loops of intestine at once protruded, rendering exploration of the abdomen exceedingly difficult. An attempt was made to overcome this difficulty by incising one or two loops

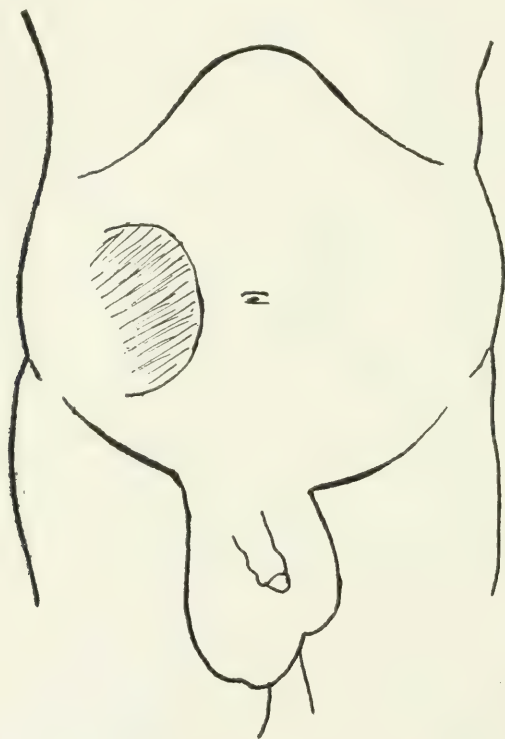


FIG. 2.—Increasing swelling and tympanites, three days subsequent to condition shown in Fig. 1.

along the free border in hope that after their contents had been evacuated the intestine would collapse enough to give room for the hand in the abdomen. But although about 500 cc. of liquid fæces were thus removed, the remaining coils of gut were little, if any, affected and still rendered any exploration of the abdomen exceedingly difficult. This failure to empty the intestine

promptly under the above conditions has since been quite satisfactorily explained by the careful study of intestinal anatomy by Dr. George H. Monks (ANNALS OF SURGERY, vol. xxxvii, p. 543, October, 1905).¹

After waiting in vain for the intestine to be emptied the incisions in the gut were sutured and the abdomen explored as

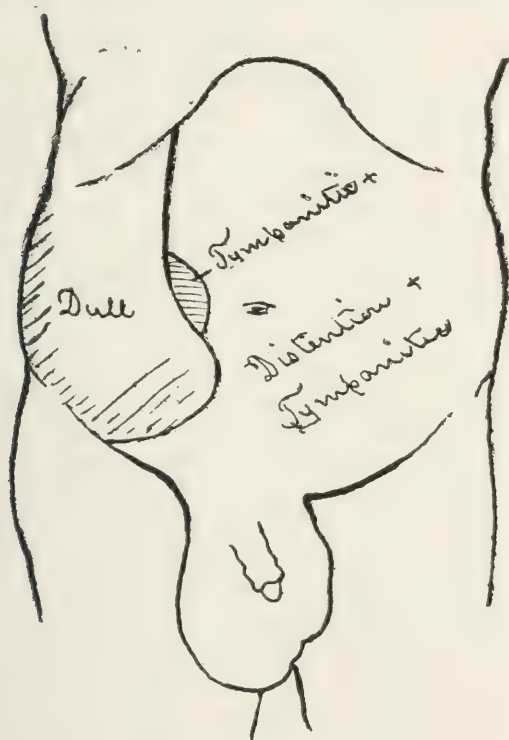


FIG. 3.—Condition on fourth day subsequent to date of Fig. 1.

well as possible, in spite of the interference from the distended coils of intestine which still filled it. No band, twist, tumor, intussusception, or other obstruction could be found. The condition of the abdomen previous to operation, shown by Fig.

¹The Mütter Lecture on the Surgical Anatomy of the Small Intestine and Mesentery, delivered at the College of Physicians of Philadelphia, by Dr. George H. Monks on December 2, 1904.

III, was found due to an enormously distended cæcum and ascending colon, for which no cause was discovered.

On account of the patient's general condition becoming alarming, which left no time for further exploration for the cause of the obstruction, the search was abandoned and all efforts directed to the end that the patient might leave the operating-room alive. To accomplish this the cæcum was rapidly exposed through an oblique incision of the superjacent abdominal wall. It was then sutured in the wound so as to close off the peritoneal cavity, and opened by a one-inch incision. Two or three litres of liquid, pea-soup-like fæces were evacuated.

A rubber tube was now fastened into the colon wound by two superimposed purse-string sutures, and the wound after being loosely packed with iodoform gauze was partly closed with two silkworm-gut sutures. The median incision was closed with "through-and-through" silkworm-gut sutures. The patient was then put to bed with syphon drainage of the colostomy wound.

There was marked shock, but the patient recovered from the ether and slowly reacted under treatment. On February 21st, the day following the operation, the temperature was 101.2° , and the pulse 128-129. The intestine gradually emptied itself through the tube in the colon into a bottle hung at the bedside, and the obstructed intestine was temporarily relieved. The vomiting ceased at once after the operation. The abdominal pain also disappeared promptly.

On February 24th the temperature had gradually dropped to 99.5° and the pulse to 98-105. The colostomy tube was removed and the lower bowel was cleaned by a high enema. On the night of the 24th, without any apparent reason, the patient twice got out of bed. During the succeeding days the patient continued to improve and gradually became stronger. The median incision was healed on March 7th. The colon wound closed in so that on March 20th it barely admitted the little finger. In the early part of April the patient's general condition had markedly improved. He was up and about daily. There was still a fecal discharge from the colon opening. It was then found that unless the intestine was emptied by laxatives and enemata every second day, symptoms of obstruction would begin to appear. It, therefore, seemed indicated that another

attempt should be made to locate and remove the persisting obstruction. The data obtained from observation of the case seemed to indicate that it was probably a neoplasm situated in the wall of the intestine and filling its lumen. On account of the distention of the colon at the time of the first operation being limited to the ascending portion, the hepatic flexure was probably its location. Therefore, on April 13th, after careful feeding and preparation, a second operation was performed.

Under ether the abdomen was opened in the median line above the navel by an incision (which before the exploration was completed was enlarged so that it extended from just below the sternum to the umbilicus) and explored.

Bands of adhesions between the intestine and the abdominal wall appeared. The separation of one of these caused an injury to the gut-wall which was closed by a continuous silk suture. The intestine was empty. Contrary to expectation, careful examination of the transverse colon and vicinity failed to discover anything abnormal. There was no obstruction at that point. Finally, after exploring the whole abdomen carefully without result, suddenly a small, hard, movable mass was by chance felt in the left iliac region. This was apparently a small indurated section of the gut, probably a tumor, involving the intestinal wall.

An oblique incision four inches long was now made in the left lower quadrant of the abdomen over the growth, and through this wound the mass was exposed. It proved to be a tight, annular stricture of the intestine at the junction of the descending colon with the sigmoid flexure. It involved the entire circumference of the intestine, forming a band about 2 cm. wide, which showed a well marked constriction. The growth was apparently well localized. With considerable difficulty it was "walled off" with aseptic gauze, isolated by rubber bands passed through the mesentery and clamped, and about two inches of colon with its adjacent mesentery resected. No affected lymph-nodes were found. The intestine was then closed by an "end-to-end" union. This was made with a "right-angle" continuous fine-silk suture, reinforced at two points by a single Lembert stitch. A very thick, fat mesocolon and the slight mobility of the growth interfered much with the application of the suture. The abdominal wound was then closed by nine deep catgut and an

interrupted superficial silkworm-gut suture. The median wound was united by "through-and-through" silkworm-gut sutures. No drainage. Dry aseptic gauze dressing.

The operation lasted one and one-half hours, but was followed by very little shock. The recovery from ether was good, and after the first twenty-four hours the patient did well. During the next few days he was quite comfortable. There was practically no fecal discharge from the colostomy wound after the operation.

The recovery from the operation was uneventful. On the fourth day the temperature and pulse reached normal and remained so. The highest temperature, 101.8° , was on the night following the operation. The highest pulse-rate, 120, was recorded twenty-four hours later. The patient's general condition steadily improved and his strength increased. After the operation no cathartics or enemata were used till April 29th. There was a spontaneous normal defecation on the seventh day. The operation wounds healed by primary union. Patient got up on the twenty-third day. The artificial anus closed spontaneously on the eleventh day after the colon was resected and the obstruction removed. On May 5th the colostomy wound was completely healed.

The patient rapidly gained in strength and weight, and was discharged apparently well on May 9, 1904.

Examination of the resected intestine showed the excised tumor to be situated in the intestinal wall, and by its growth to have so occluded the lumen of the intestine as to leave an opening only 2-3 mm. in diameter. The microscopic examination made under the direction of Dr. F. B. Mallory, at the Pathological Department of the Boston City Hospital, showed the tumor to be an adenocarcinoma, and that it apparently had been resected well beyond the limits of the growth.

The patient has continued under observation till the present time, a period of two years since the removal of the cancer. He has had very little discomfort during this period and is apparently well. It was four or five months before he fully regained his strength. On May 3, 1906, I could detect no signs of recurrence. He states that there has been at times some discomfort at the site of the colostomy wound. This gradually became much less frequent than at first, and at present is scarcely

noticed. He says that he "can feel everything that he eats passing through there." The intestine acts normally, one daily dejection without the aid of medicine. He has recently increased in weight thirty pounds. Examination of the abdomen is negative. The scars are firm and do not bulge on coughing. (Fig. 4.) There is no tenderness.

The prognosis in this case is good, since the possibility of removal and freedom from recurrence—if not permanent, at least for a term of years—in cases of this form of adenocarcinoma of the colon, has been demonstrated, especially where the growth has not spread outside the intestine. There are results of this character on record, and such has been the result of those cases which have come under the personal observation of the writer.

The above record is a fair example of one type of colon obstruction, and when considered in detail presents certain features which seem worthy of attention, viz.:

1. It is important to recognize the character of the obstruction, whether it is transitory or permanent. Accumulated *fæces* resulting from chronic constipation due to functional causes can present a clinical picture similar to organic obstruction in the earlier stages. Chronic obstruction is more apt to be obscure. The symptoms and clinical picture are not so characteristic as in the acute cases, such as strangulation, volvulus, intussusception, etc. In cancer, as a rule, the occlusion is so gradual that a diagnosis is usually made only after the obstruction has so occluded the intestine as to produce marked symptoms—pain, nausea, vomiting, distention, complete constipation. In elderly people a history of persistent constipation requiring the more or less constant use of drugs should always attract attention and the possibility of cancer of the colon be considered.

2. Equally important is a recognition of the site of the obstruction. This is often difficult since the abdomen is a region where the anatomy and pathological physiology of its contents are varied and complex. Data obtained by exter-

nal examination cannot always be accurately interpreted. For instance, it is usually accepted that an obstructed gut is distended above and collapsed below the point of obstruction. In the case just reported both external and internal examination showed the colon with marked distention as far as the hepatic flexure, while beyond that point it was of normal size, if not smaller. Yet notwithstanding this the lesion causing the obstruction was low in the descending colon. For this condition no wholly satisfactory reason has been suggested.

Again, this lesion may be so small, affecting only the intestinal wall, as to be readily overlooked by the surgeon during exploration, especially when the abdomen is filled with distended coils of intestine. It must be actually seen or felt to be recognized. Many instances have been recorded where a condition apparently probable from clinical data at hand has been found by exploration not to exist in fact. Hence the difficulty of locating such an obstruction.

3. Another problem presented to the surgeon is the expediency of finishing the operation in one or two sittings. In suitable cases there is no question but that a single operation is to be preferred. When the patient's general condition is good, and the wall of the intestine normal or nearly so, a growth can be excised at once, but in many of the cases certain conditions obtain which are unfavorable for immediate resection.

First. The ability of the patient to endure the severe shock resulting from the prolonged manipulation. A patient is often already in a critical condition from the effects of his illness. If he can be temporarily relieved by some expedient, as an enterostomy or colostomy, the operative exposure is diminished and a life saved which otherwise would be lost.

Second. The conditions for exploration and resection are much more favorable for efficient thorough work at the second operation. It is performed in an abdomen containing only an empty intestine in place of an extremely dis-



FIG. 4.—Showing scars left after repeated abdominal sections for relief of intestinal obstruction.

tended one. It is performed more easily, since the operation is not impeded, and consequently is finished much more rapidly. All of which, of course, shortens the exposure and diminishes the shock. By the temporary relief obtained from the first operation there is an opportunity for the patient to recover and he will therefore be in a much better general condition to endure the second. In the case reported, if the attempt to find the obstruction and resect the colon had been persisted in at the first operation the patient would probably have died at once.

Third. The chances of successful union are much greater when a normal empty intestine is sutured than when a semi-paralyzed one full of stagnant fæces, toxins or ptomaines, is the site of operation. At the primary operation the intestine is apt to be dilated, its muscle exhausted, its wall thickened and oedematous, the contents especially septic; in short, the whole situation is most unfavorable for successful wound union. In a recent article on this subject Dr. J. W. Elliot¹ states that the mortality from the usual operation of enterectomy with immediate suture is 50 per cent. at least in the hands of the best surgeons, and in some hospitals as high as 85 per cent. The principal cause of death is septic peritonitis, due sometimes to infection by intestinal contents at the operation, but more often to the fact that the most perfectly placed sutures or mechanical devices do not hold. He attributes the giving way of the suture to the diseased condition of the bowel at the time of operation. He recommends enterostomy or colostomy, with later enterectomy, in patients unable to bear primary enterectomy, and regards this as the operation of choice in all critical cases of intestinal obstruction. The method of operation in two sittings is not new. It has been practised and published by many surgeons of note, but notwithstanding this its value is still often lost sight of in the surgeon's

¹ ANNALS OF SURGERY of 1905, Vol. xlii. p. 668. "The Management of Certain Critical Cases of Intestinal Obstruction, with Report of Cases."

zeal to complete his work at one sitting. But in these cases temporary relief is of far more immediate importance than the removal of the disease. I therefore wish to emphasize the importance of this method.

Fourth. Another fact to be considered is the futility of an attempt to rapidly empty a distended, half-paralyzed intestine by incising separate coils. Such incisions have only an immediate local effect. To accomplish the desired object the drainage must be continued for several hours. The surgeon cannot wait so long for the necessary result. The slow emptying of the incised gut, as Dr. Monks has explained, is caused not only by the sharp curves and kinks which the mesentery causes in a distended intestine, but also to external pressure and especially to the gas and semi-liquid contents which act like plumbers' traps. The fluid portions are in the dependent loops and obstruct the passage of gas. The gas is in the upper part of the coil and cannot pass the liquid. Neither gas nor liquid can pass on without the peristaltic wave, which is absent in a paralyzed gut. But when an artificial anus is made and continual drainage through a tube is established, the intestine after a time is able to empty itself and gradually recovers. Both the above facts were demonstrated in the case of the patient under discussion,—*i.e.*, the futility of immediate and the success of continued drainage.

Fifth. The question arises also in these cases, where first a palliative and after relief a second radical operation is performed, as to the comparative value of internal procedures, such as lateral anastomosis for the purpose of "side-tracking" the obstruction, or of the method of external drainage, as by a colostomy. Some operators prefer the internal method; others select the internal for the less severe cases and the external for the extreme ones; while another set prefer the external in nearly all cases. There can be no question that in some cases where the intestine is in good condition this internal method can be safely performed and possesses advantages which readily suggest

themselves. But in the severe cases where the gut is in an abnormal condition the "external" drainage has more advantages. One has positive knowledge that the drainage is efficient. If necessary it can be assisted. It has also occurred that a section of paralyzed gut from absence of peristalsis has caused as effective an obstruction as a strangulation, and unless the anastomosis in such a case is beyond the paralyzed area the patient would not be relieved. Again, operations done on intestines under these conditions and with contents of such a character are often followed with marked local reaction. I have seen the resulting œdema at the point of suture so great as to occlude an opening having the same lumen as the gut. By the external method such changes can be at once noted and treated. One always has a much more accurate knowledge and control where local conditions are open to inspection and manipulation. Therefore, it would seem wise to employ the "external" method unless the surgeon can feel sure that the condition of the intestine is normal or nearly so at the point of suture. There is no objection to the temporary fecal fistula from fear that it cannot be closed. The tendency is to spontaneous closure after the obstruction is relieved. In this case it closed spontaneously on the eleventh day. If this does not occur it can usually be closed by operation. The objection has been made that the presence of an open fecal fistula greatly increases the danger of infection at the second opening of the abdomen. It is true that this danger exists, but by proper preparation and technique it can be avoided. In the case reported an extended exploration of the abdomen was made through a median incision and the colon was resected through an iliac incision notwithstanding a fecal fistula had been emptying the cæcum on the right side up to the day of the operation.

It is also claimed that the delay resulting from postponing the radical operation offers an opportunity for increased growth and extension of the neoplasm, and for the production of pathological changes in the adjacent tissues

unfavorable for operation. On the other hand, however, in those cases where the tumor is found it can generally be isolated and sutured outside the abdomen by one of the several methods already in use. Then at the second operation the growth can be excised and the colostomy opening closed. When the obstruction cannot be found the operator has, of course, no choice. He must drain externally. He has nothing to resect.

Sixth. In conclusion I would call attention to the method of multiple incisions for an extended exploration of the abdomen in place of a single long incision. By this method important structures, such as nerves, vessels, and muscles, remain uninjured and the patient escapes the disagreeable after-effects of such injuries. Also an incision directly over the area in question gives direct access to the site of operation in place of the indirect approach obtained only by powerful retraction of the edges of an incision placed at a distance. No single incision can be placed in the abdomen which will possess the above-mentioned possibilities without much increased risk to the patient and injury to important structures of the abdominal wall. The accompanying photograph (Fig. 4) shows the results of this method.¹ The two wounds in the median line overlap so that the resulting scar is only two inches shorter than the distance from the xyphoid tip to the pubes. There is a four-inch oblique scar in the left iliac region and a rather broad, depressed, three-inch oblique cicatrix in the right iliac area at the former site of the temporary artificial anus. All are firmly healed and show no tendency to hernia. The tonicity of the muscles is apparently normal.

¹ This photograph was taken on May 12, 1904. The resection wound now appears almost as a line scar, with no suture marks. The photograph shows a reversed or "mirror" picture, the right colostomy scar appearing on the left, and the left resection wound appearing on right.

INDIVIDUAL EXCISION AND SUTURE IN OPERATING FOR THE REMOVAL OF HEMORRHOIDS.¹

BY LEWIS STEPHEN PILCHER,

OF BROOKLYN, NEW YORK,

Surgeon to the Methodist Episcopal and to the German Hospitals.

THE method which forms the subject of the present communication, in its details, has been elaborated in my work at the Seney Hospital, in Brooklyn, during the past few years. It has given much satisfaction, and from its simplicity and the freedom from unpleasant complications in the after-course of the cases thus treated, and the certainty and security of the healing which has followed, seems to be almost ideal in its character. Doubtless similar methods have been used by other surgeons, but I do not know of any full and systematic description of the procedure as a whole either in periodical or text-book literature.

It is true that the old methods of removing hemorrhoidal masses by ligation, or by the clamp and cautery method, have been quite efficient in securing the cure of the disease in all ordinary cases of hemorrhoids; nevertheless, to the critical surgical mind it has always been a fair objection to these methods that they lack that finish, that completeness of fine surgical technique, which in these days of more perfected surgical methods ought to be given to such cases as well as to others. The complete excision of the so-called pile-bearing segment of the rectum, in cases of very aggravated hemorrhoidal degeneration, the method of Whitehead, is complete as a surgical procedure. The diseased structure is removed in toto; the parts from which the disease is excised are brought together in good apposition; and a primary union is accomplished. In certain cases it is a method which ought to be resorted to, and must be if perfect

¹ Read before the American Surgical Association, May 30, 1906.

relief is to be secured; such as in cases where the lower segment of the rectum is practically converted into a continuous, circular, cavernous tumor, mixed with inflammatory products, in which there are no longer present the discrete masses which are found in most cases that call for attention. It is, however, of the general cases of moderately severe hemorrhoids (Fig. 1), such as most frequently apply for surgical relief, for which the method of Whitehead is unnecessarily severe and extensive, that the method which I now describe is applicable; cases to which the old methods of ligation or of the clamp and cautery were peculiarly applicable and were most frequently resorted to.

Whatever the method of operating, the antecedent preparations are the same,—viz., the emptying of the bowel 24 or 36 hours previously by a cathartic, and the washing out of the lower bowel by a copious enema not later than eight hours before the operation, so that the rectum is thoroughly empty when the parts are subjected to surgical interference. Complete surgical anæsthesia, the exaggerated lithotomy position, thorough dilatation of the sphincter,—all these are to be used in any procedure, and are to be resorted to in the cases now to be described.

The sphincter having been divulsed (Fig. 2). the lower segment of the rectum rolls out and is readily and fully exposed to view, so that a full estimation of the nature and extent of the disease is presented.

The next step is also common to all methods, determining how many of the hemorrhoidal masses, and what ones, should be removed. This is best effected by seizing the projecting masses with as many pairs of ring-forceps (Fig. 3) as may be required, according to the judgment of the surgeon. Up to this point nothing peculiar in the method has developed; but from this point my own method begins to present its special features.

One of the masses grasped by the ring-forceps (as a rule one located at the posterior commissure of the anus is first to be chosen) is pulled out so as to put the parts at its

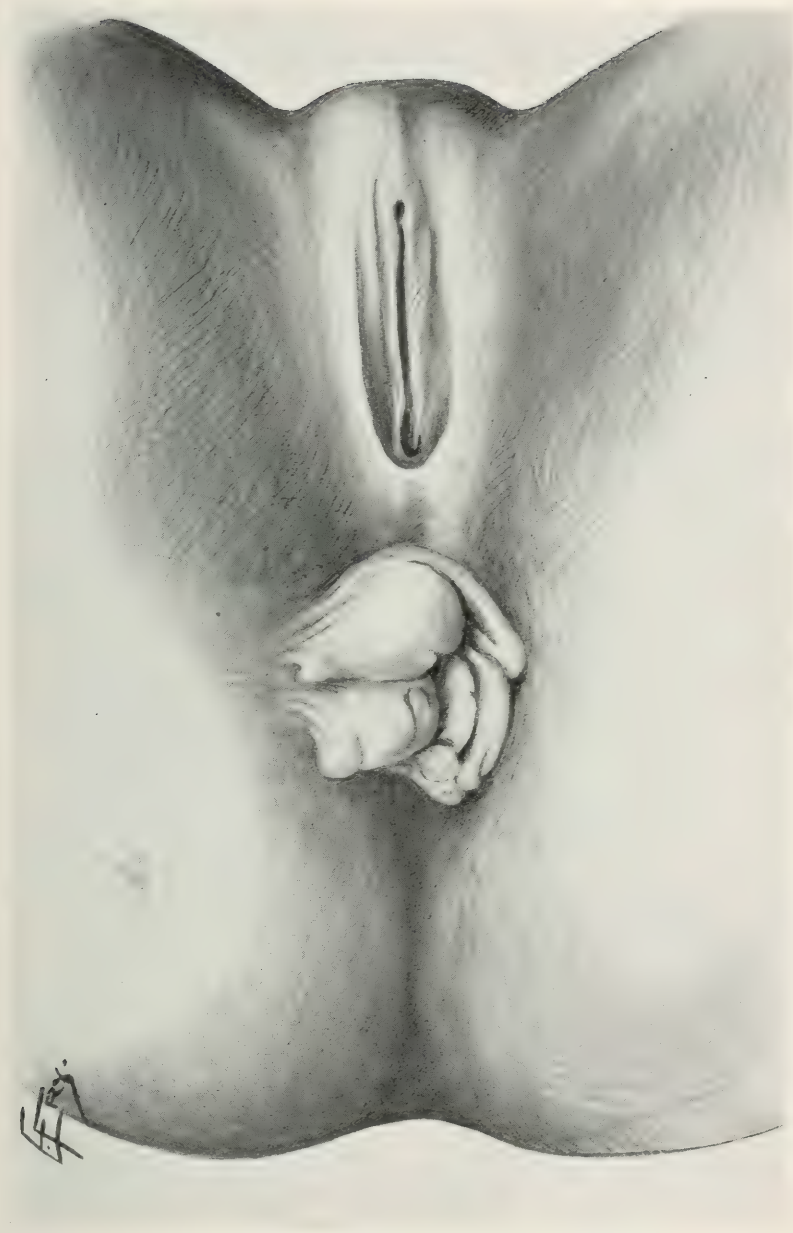


FIG. 1.—Protruding hemorrhoids of moderate size. (Sketch made in operating room immediately previous to operation for removal.)



FIG. 2.—The dilatation of the sphincter ani.

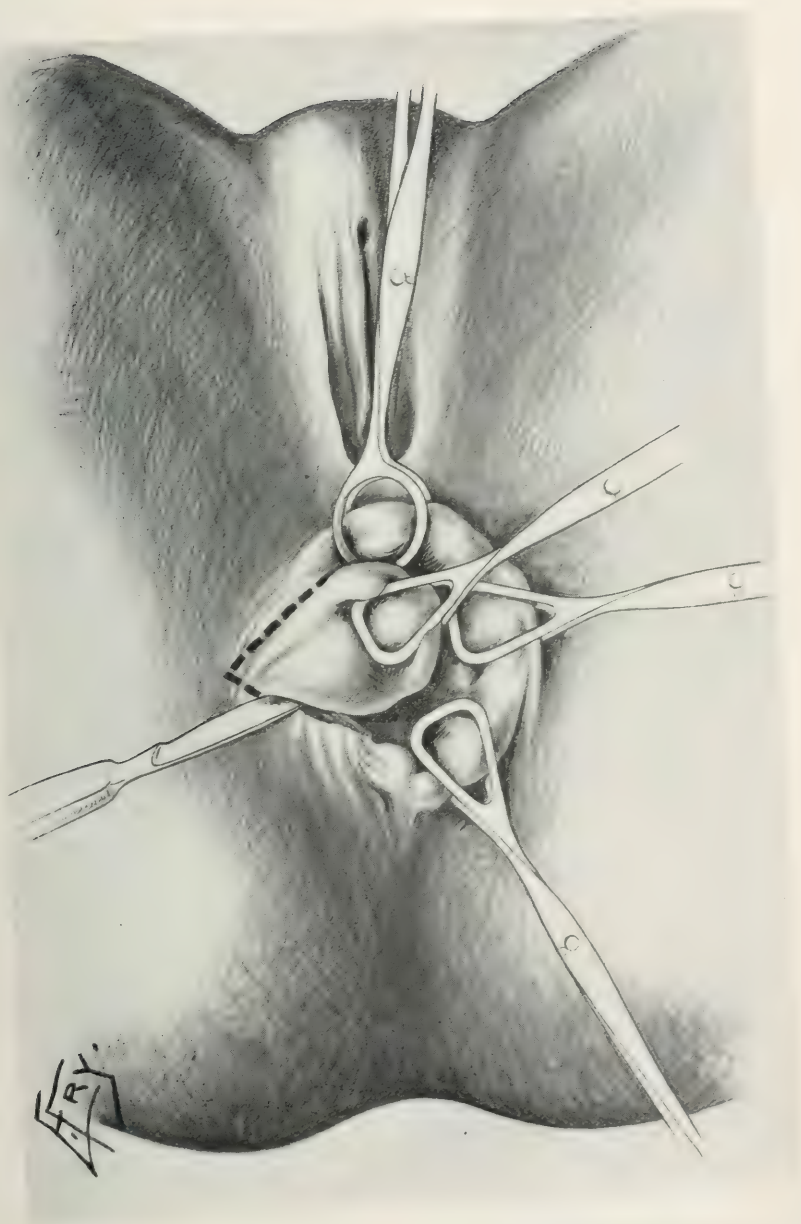


FIG. 3.—The most discrete hemorrhoidal masses seized by ring forceps; one is being loosened from its base externally by the knife.

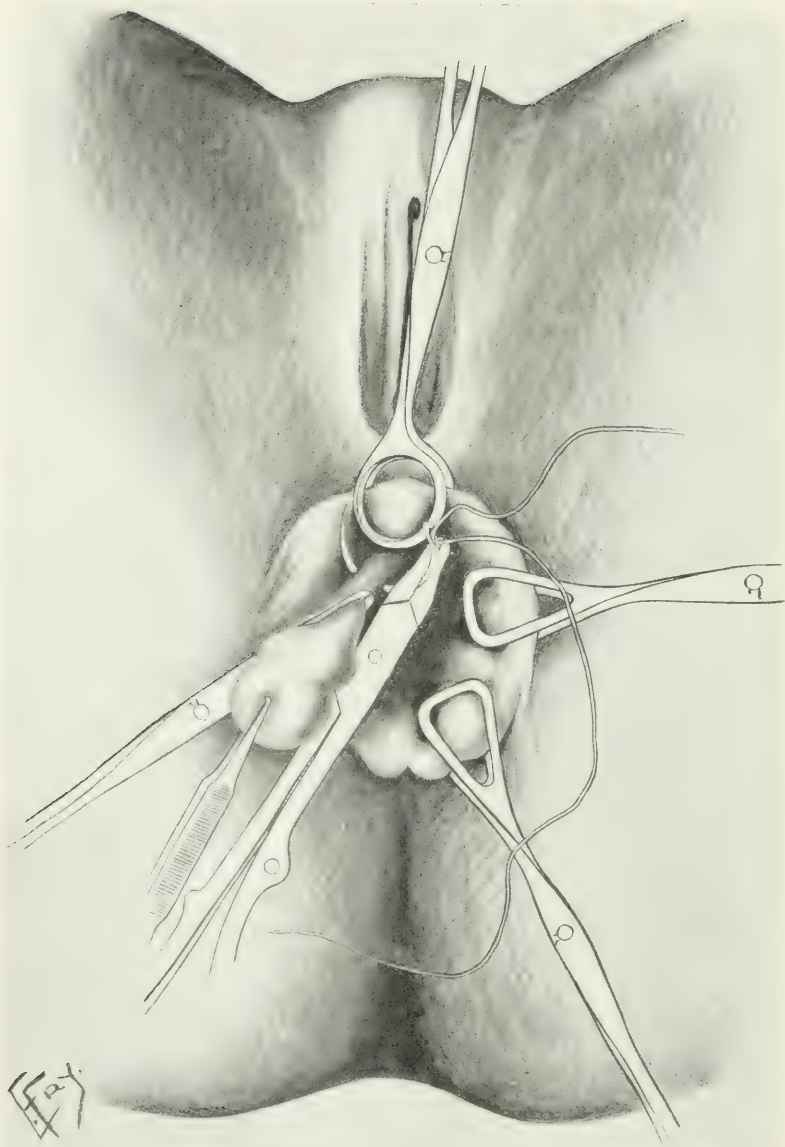


FIG. 4.—The loosened hemorrhoid attached by pedicle of mucosa, which is clamped by hæmostatic forceps; a ligature is being passed through the fold of the mucosa above the point grasped by the clamp.

base well upon the stretch. Since the lower edge of the ring applied to the pile involves the muco-cutaneous junction, as the base of the pile is put upon the stretch, there is produced a cone whose apex passes upward to the normal mucous membrane, and its base passes outward upon the normal skin surrounding the anus. Then a longitudinal incision through the mucous membrane and skin on either side of this cone at the muco-cutaneous junction is made (Fig. 4), which passes out onto the skin of the neighboring perianal region so as to include as long and as extensive a triangle of skin as may be required to obtain a desired retrenchment of the redundant perianal skin, when the final suturing of these incisions shall have been done.

Owing to the vertical direction through which the blood-vessels of the lower rectum descend in the submucosa to the margin of the anus, it is possible to make these vertical incisions described on either side of the telangiectatic mass grasped in the forceps, without producing much hemorrhage.

Then, beginning with the apex of the little triangular flap of skin that has been marked out, this is dissected up from the fibres of the sphincter to the base of the pile mass above; as the result of this, the mucous membrane on either side of the pile having been divided from the tissue on either side by the preliminary longitudinal incisions, and the skin-flap to be removed having been raised up, the continued traction of the ring-forceps raises and isolates to a suitable extent the whole pile mass. Now, if into the sulcus thus produced an ordinary pair of Kocher's hemostatic forceps is thrust up so as to grasp the comparatively narrow pedicle of the pile (Fig. 5), it will not only enclose the whole of it but will reach up to the normal mucous membrane above, so that its vascular supply is wholly controlled. Practically, the situation is the same as when the surgeon applies the clamp for the cautery operation. The portion of the pile that protrudes beyond the clamp is now cut off flush with the clamp by knife or scissors, just the same as in the cautery operation. The special point of the method now presents itself.

Remembering that the chief blood-supply of this pile descends into the submucous tissue vertically from above, if underneath the fold of mucous membrane which is just above the point reached by the clamp (Fig. 6) a curved needle, armed with ligature threads, is passed well into the submucous tissue, and, being drawn through, carries such a thread, when it is tied the main blood-supply of the parts below is cut off.

This is the key to the situation,—the passing of this needle through the fold of mucous membrane just above the point reached by the clamp, and the application of the ligature at this point, tied tightly.

For this ligature chromicized catgut is to be preferred, and it should be long enough to serve not only for this primary point of ligature, but also for the subsequent suturing now to be described.

The needle, still armed with the long end of the ligature thread, is now carried as a running suture around the mass in the grasp of the clamp, passing through the mucous membrane and the tissues underneath the arms of the clamp two, three or four times, as the extent of the disease may seem to require, until all of the tissues grasped by the clamp have been included. (Fig. 7.) The clamp is now loosened by slight manipulation, and withdrawn, after which the ligature is drawn up tight, by which maneuver the entire site of the pile is included in the line of suture down to the point of the mucocutaneous junction.

If the incision has been at all extensive, it is well to knot it here and suture the skin incision outward by a separate line of suturing. In the less extensive cases, the original line of suturing can be made to include both the mucous and skin incisions without interruption. Thus the surgeon has secured himself from the dangers of hemorrhage by preliminary ligature of the vessels of supply ascending from above; the securing of all the tissues of the wound by suture has been provided for by the way in which the needle is passed successively through the tissues which were

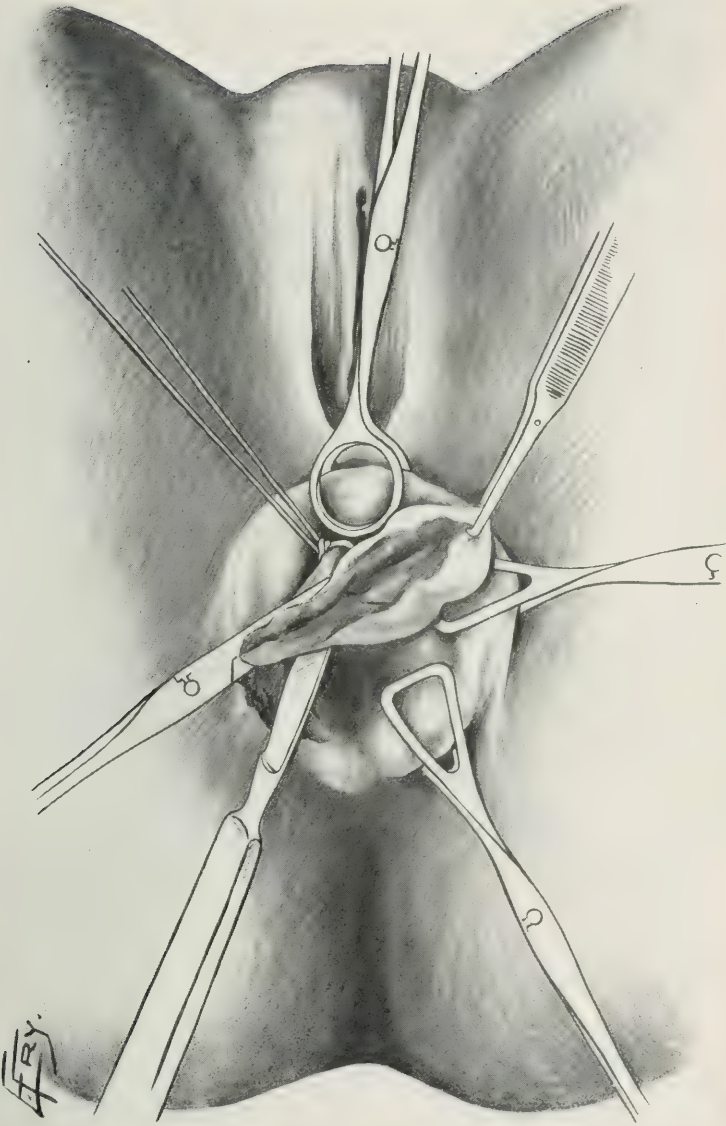


FIG. 5.—The hemorrhoid is cut away.

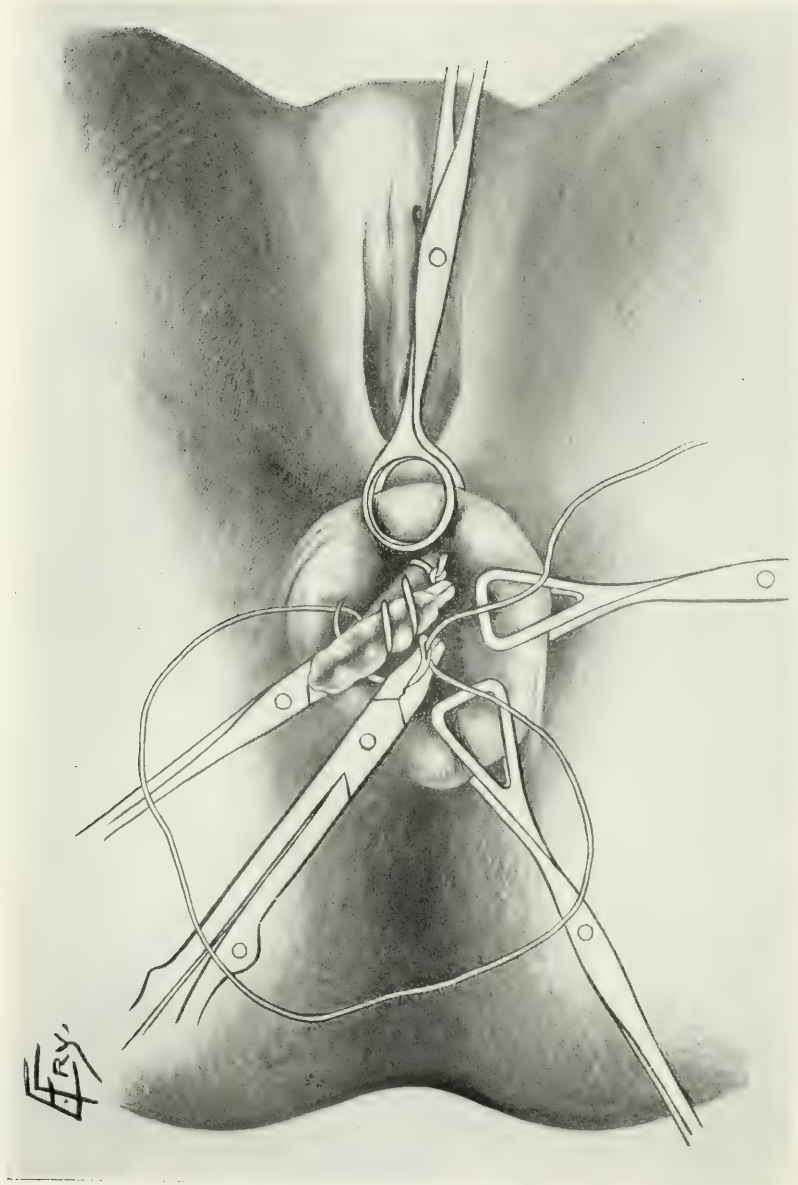


FIG. 6.—The ligature is passed as a running suture over the stump of the pile and beneath the grasping clamp.

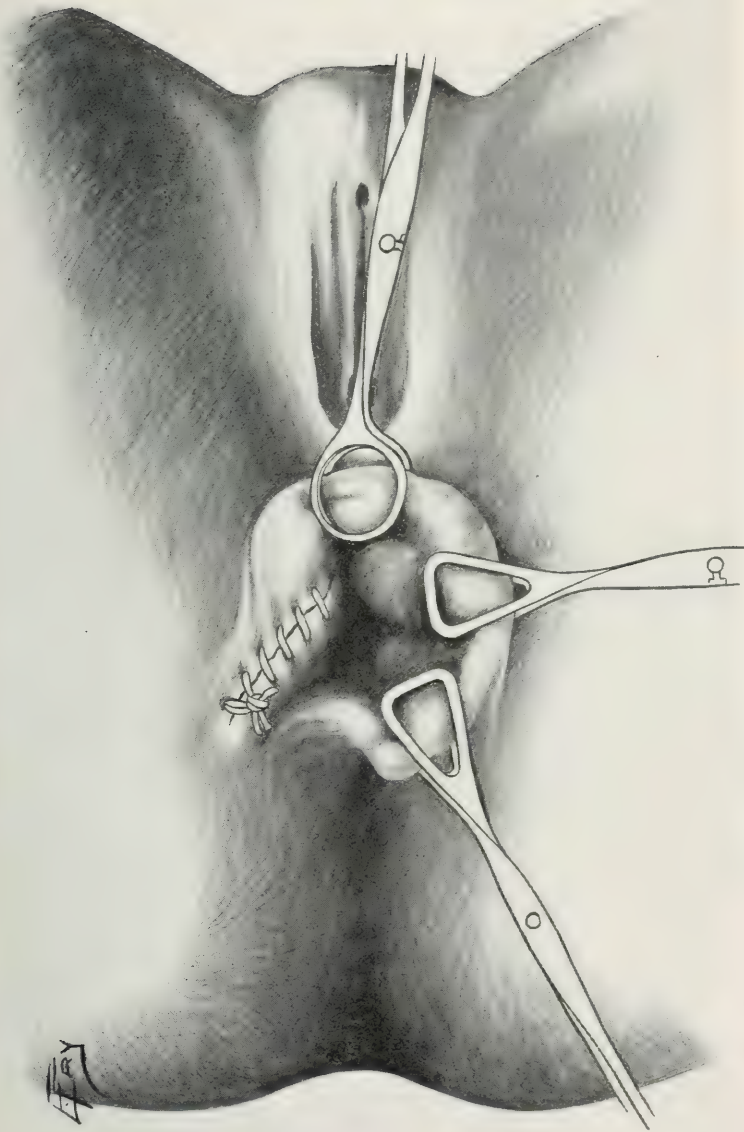


FIG. 7.—The clamp is removed, and the suture is drawn up and tied.



FIG. 8.—The completed operation, as presented after the removal of multiple hemorrhoids.

grasped by the clamp. It may be noted here that if the clamp is not applied with enough force there is the possibility that some of the tissues grasped in it may slip out after the cutting away of the pile mass; this should be thought of in the application of the clamp and the necessary strength of blade and force of grasp should be secured by the surgeon. My own experience, however, has been that even when such slipping of the cut parts has occurred, it gives but little trouble to secure them by suitable additional suturing, for the parts are well exposed to view and are thoroughly under control.

When the procedure has been completed there results a well- and satisfactorily-secured wound; the wound surfaces are in apposition, the perianal skin redundancies have been in great part removed, and the traces of the operation there present to inspection two, three or more small sutured wound-lines radiating from the anus. (Fig. 8.)

In my own experience, the after history of cases thus treated has been uniformly smooth; much less pain, either immediately following the operation, or later, has been complained of by patients than in other methods of operating. The tendency to the formation of hematoma or of oedematous swelling has been comparatively slight, and, thus far, wound infection has been escaped, although it is not to be denied that the work in all cases is done in an infected field, owing to the impossibility of perfectly cleansing the parts to be operated upon, or of preventing the subsequent access of fecal materials from above.

The simplicity of the method and its completeness as a surgical procedure have commended it to our judgment, as well as the satisfactory after-course and the completeness of the restoration of the parts to their original integrity.

The subsequent treatment does not differ from that commonly employed in any method of dealing with hemorrhoids. A suppository containing $\frac{1}{4}$ gr. of morphia, 1 gr. ext. hyoscyamus, 2 gr. iodoform, is inserted into the rectum, and a compress of iodoform gauze is applied against the anus

supported by a larger compress of ordinary gauze and a T-bandage. The bowels are kept quiet by moderate doses of tincture of opium until the third day, when a laxative is administered, the first movement produced by which is rendered easy by the administration of an enema of 6 oz. of olive oil.

The patient is allowed up at the end of one week.

THE TREATMENT OF ECTOPIA VESICAE.¹

BY F. TRENDELENBURG, M.D.,

Professor of Surgery in the University of Leipzig, Germany.

THE repair of congenital defects of the urethra and bladder constitutes one of the most difficult and for that reason perhaps one of the most interesting chapters in plastic surgery, and if the outcome be successful it may be regarded with intense satisfaction. During the past fifty years many surgeons have occupied themselves with the solution of this problem, and many have been the attempts to devise a method by the aid of which, even in the severe types of the deformity, a restoration of the normal bladder form and normal bladder function could be secured. Up to the present time, however, this ideal has not been reached.

In passing I desire to refer very briefly to some of the essential facts in the history of this subject. In uncomplicated cases of epispadias Dieffenbach effected a cure by freshening the edges of the opening and then uniting them by direct suture. Where the cleft extended into the bladder itself, he regarded operative interference as practically hopeless. Thiersch then introduced a method by which the defect was covered with a neighboring skin-flap and it was he who first succeeded in producing in front of the bladder left everted an enclosed narrow space in which by the aid of a special mechanical contrivance which exerted pressure on the neck of the bladder, the urine could be retained.

For more than twenty years I have endeavored to aid the direct union of the freshened edges in cases of ectopia by producing a separation of the pelvic bones at the sacro-iliac synchondrosis in order to provide for a closer approximation of the two halves of the pelvis anteriorly at the

¹Read before the American Surgical Association, May 30, 1906.

symphysis and consequently of the edges of the defect. Only a limited number of surgeons have made use of my method, because the bilateral separation of the os ilei from the sacrum was generally regarded as a very dangerous procedure, and the attempt to produce a bladder in this way which was capable of retaining some urine was not uniformly successful.

Although the latter fact cannot be denied, there is little occasion for fear as regards the separation of the pelvic bones in the manner indicated if the operation is done before the seventh or eighth year. In adults the procedure is undoubtedly much more difficult and dangerous.

In abandoning the attempts to restore a normal bladder cavity, recourse was again had to an idea first proposed by Simon, who suggested that the urine should be diverted into the lower portion of the intestinal canal. In this way there was developed the method now recognized by the name of Maydl, which is characterized by the implantation of the ureters into the sigmoid flexure. The continence which is thus attained may be made to extend over several hours. One of the dangers, however, which is associated with this method is the production of a pyelonephritis, from the entrance sooner or later of some of the intestinal contents into the ureters. Gersuny, Borelius, Mueller, Muscatello and Wehr have all suggested various ingenious modifications for obviating this difficulty, but none have succeeded in entirely overcoming it. And aside from the actual danger to life, the unnatural manner in which the urine must be voided per anum constitutes a great annoyance, particularly to patients of the male sex.

I am quite convinced, therefore, that the advent of Maydl's operation has in no way arrested the further development of plastic surgery in this field, but I believe that very probably ureteral transplantation will again be abandoned and recourse be had to direct suture of the edges of the deformity under discussion as the only means by which the normal relations can be restored. I myself have always



FIG 1.—Result of operation for ectopia vesicæ after the method of Trendelenburg. Power of retaining urine, afterwards lost again.



FIG. 2.—Result of operation for ectopia vesicæ after the method of Trendelenburg.



FIG. 3.—Epispadia with fissure of neck of bladder. Fissure of pelvis.
Boy retained urine for two hours.



FIG. 4.—Ectopia vesicæ. Inguinal herniæ. Result of operation.

adhered to this plan, and I now ask your kind permission to describe what I have accomplished along these lines and in what respects I have failed.

As regards my cases of bladder ectopy which were operated upon years ago, I desire to say that there are two patients living whom I have had under observation almost continuously and a third who has been seen occasionally. In all three patients the defect, which extended from the umbilicus down to the glans penis, is completely closed and no fistulous openings are present. The form and shape of the penis itself are moreover quite satisfactory. The bladder when distended consists of a spherical cavity lined with mucous membrane over its greater extent. The passage of small concretions is occasionally observed by these patients but the tendency to calculus formation is by no means as marked as in certain cases operated upon by Thiersch which I have had occasion to examine. These patients partly suffered to such an extent from the production of calculi, incrustations and ulcerations in the irregular crypts of the bladder, that they demanded operation by some other method for the relief of their condition. (Figs. 1, 2, 3, 4.)

Retention of the urine is not complete in any of my three cases. These young men, therefore, wear a contrivance supplied with a small spring which compresses the urethra at the root of the penis either from the front or the back. The patients are now students in college; they are not greatly inconvenienced by the apparatus, and by proper care and attention they avoid the production of any odor which would serve to attract attention to their condition. If the spring is raised with the finger, the urine issues forth in a stream. On lying down it collects in the bladder without leakage. One of the men remains dry throughout the night, he may be awakened once or twice by the desire to urinate and even when he gets up he can voluntarily retain the urine for several minutes and then pass it naturally in a stream.

A fourth patient, a boy of five, could also, when he tried, retain his urine for several hours when standing or walking, but later on, at the time of his leaving the clinic, this ability was lost.

Both of the two cases last mentioned demonstrate that the physiological factors necessary both for retention and voluntary micturition are present, and that they are merely prevented from functioning in a normal manner by certain mechanical conditions. The reason for the failure may be accounted for by the fact that the two sections of the pelvis which have been separated at the sacro-iliac synchondrosis have a tendency to gradually resume their former positions, therefore the neck of the bladder and the prostatic portions of the urethra which are closely connected with the pubic bones, are pulled upon to such an extent that the muscular ring can no longer be brought into play.

I have made several attempts to overcome this difficulty by mobilizing the pubic bones with the help of the chisel or by dissecting widely the attachments of the urethra and the neck of the bladder to the latter. In no instance of complete ectopia have I been favored, however, with a permanent result. Such a procedure, moreover, is apt to lead to the production of a dense scar along the vesical neck, which in the event of a later secondary operation will be found a source of as great annoyance as the cicatrices in a harelip which has failed to heal by primary union.

In cases of epispadias associated with incontinence, as well as in patients who present only a partial ectopy involving merely the vesical neck, the prognosis is more favorable. In these transitional types between simple epispadias and ectopia vesicæ there is also lacking a proper union at the symphysis pubis, but the separation at this point is not so extensive and consequently there is much less lateral tension on the neck of the bladder and the urethra after operative closure.

It is well known that in certain cases of epispadias where the infundibulum is narrow, the previously existing

incontinence may be overcome by direct suture of the urethra after the free edges of the latter have been freshened. But even if the infundibulum is sufficiently large to admit the tip of the little finger and a slight prolapse of the posterior wall of the bladder follows either coughing or straining, there is still some hope that continence may be restored. It is merely necessary in such cases to bring about a narrowing of the muscular ring (around the neck of the bladder) by the excision of a sufficiently wide wedge-shaped section from the upper border of the infundibulum and then carefully closing the resulting gap with buried catgut sutures. If it is found after operation that the urine still fails to be fully retained, then it becomes necessary to repeat the procedure, a larger strip being taken than on the former occasion.

In cases marked by a broad infundibulum and a partial ectopy of the bladder it is advantageous to make use of the space between the pubic bones at the symphysis to gain approach to the vesical neck and the prostatic portion of the urethra, which may be thus more readily freed. A vertical incision is made through the skin over the region of the symphysis and carried down between the pubes to the anterior wall of the bladder and the infundibulum. By means of two strong sharp retractors the pubic bones may then be forced apart and through the space thus gained and with the patient in the elevated pelvic position, the trimming of the edges of the ectopic bladder and subsequent suture is greatly facilitated. Enough tissue should be removed to leave broad bleeding surfaces which may then be approximated with catgut sutures. In the region of the neck of the bladder the edges are turned in and brought together with a suture similar to that employed by Lembert for the intestine. The caliber of the new urethra is controlled by a small catheter previously inserted, but this should be removed at the close of the operation, otherwise it will exert a dangerous degree of pressure on the suture line. In place of it there may be substituted

a small drainage tube, which is inserted through a special opening made in the anterior wall of the bladder. The suture of the skin wound then completes the operation.

I obtained in this manner a perfect result with only a single operation in a boy of 12, to whom some of the photographs herewith presented refer (Figs. 5, 6, 7, 8). An X-ray disclosed the cleft in the pelvis, the pictures of the genitals show clearly the broad infundibulum; one picture was taken during the operation and another depicts the urinary stream during voluntary micturition.

A few years ago I also had an opportunity of operating upon a female patient for epispadias. In women, as is well known, this condition is much more infrequent than in men. Guetschow was able to find only thirty-five instances of this deformity reported in the literature. Strange to say there is no reference made in any of these cases to a cleft in the pelvis, although we must expect to find it, inasmuch as the condition is analogous to that in the male, and as in the severe cases a cleft of the bony structure is certainly always present. In the absence of an X-ray examination this feature may however escape notice. In a little girl of five, operated upon by myself, the separation at the symphysis amounted to three centimeters, and the picture of the external genitals was the usual one associated with epispadias of a marked degree. The labia majora and minora were separated above, and at the anterior end of each labium minus was situated a half of the divided clitoris. Above the hymen one could look directly into the infundibulum, the inferior wall of which was lined with the mucous membrane of the widely-gaping urethra. Through this infundibulum it was readily possible to introduce the little finger into the bladder. On straining, a small section of the posterior wall of the bladder came into view; years ago, according to the statement made by the child's parents, the greater portion of the bladder prolapsed through the opening. We had to deal, therefore, with an extreme degree of epispadias, but with only a partial ectopia of the bladder.



FIG. 5.—Epispadias with fissure of neck of bladder. Fissure of pelvis.



FIG. 6.—Epispadia with fissure of neck of bladder. Fissure of pelvis.



FIG. 7.—Ectopia vesicæ. Result of operation.



FIG. 8.—Epispadia with fissure of neck of bladder. Fissure of pelvis.
Functional result of operation. Boy retains urine for two hours.

As there was a well-marked diastasis at the symphysis, and as a good union of both bladder and urethra was to be expected only if the lateral tension could be eliminated, the first step in the operation consisted of the bloody separation of the pelvic bones at the right sacro-iliac synchondrosis. It was found that this was sufficient to permit of the complete approximation of the two halves of the pelvis anteriorly. The freshening of the edges and the suturing of the cleft in the neck of the bladder was carried out just as in the previous case, and then the symphysis was wired. After healing took place, the incontinence continued because the urethra and the neck of the bladder were still too wide. The entire operation was therefore repeated a year later, the wire suture being first removed, the two halves of the pelvis forced apart, the urethra and the neck of the bladder incised and narrowed and the silver-wire suture finally replaced at the symphysis. The result of this procedure was continence during the day extending over several hours, and complete retention during the entire night. The wire suture was the cause of the production of a fistulous tract, but the latter closed when the suture which had already cut its way through the bone was extracted. And now after a period of six years the result is still perfectly satisfactory.

The question naturally arises, why was not a similar effect obtained in cases of complete vesical ectopia? The explanation may be found in the fact that it is impossible in these cases to bring together the pelvic bones in front and to keep them permanently in position. Wiring of the bones particularly in boys cannot be advantageously employed, because the wire comes in conflict with both the bladder and the penis. In younger children, moreover, the wire is very apt to cut its way through the tissues.

I am of the opinion that it would be wise to go back to the old idea advanced by Demme and Passavant and to make an attempt to bring about the desired changes in the bony structures of the pelvis by orthopedic measures. The rapidly-growing osseous tissues of the young do not offer

much resistance to even slight degrees of pressure provided it is constantly applied. The bone yields and gradually undergoes marked alterations in form and contour. Thus we find in cases of congenital macroglossia with prolapse of the markedly hypertrophied tongue, that the constant pressure of this soft tumor on the anterior portion of the inferior maxilla is such that in the course of years the middle section of the lower jaw assumes an oblique position and the alveolar process with the incisor teeth is turned entirely forward and downwrđ. Ordinary soft mucous nasai polypi, if large or numerous, are liable in young individuals to displace the bony frame-work of the nose and thus to produce marked facial deformity. And the effect of constant though comparatively slight pressure intentionally applied to infantile bones is well illustrated by the feet of the Chinese women. The mother begins according to the statement of Perthes the treatment of her daughter's foot in her fourth to fifth year, applying a bandage twice daily in such a manner that the foot is held in a position of plantar flexion. The bandage causes so little pain that the child does not even cry and yet the treatment is so effectual that the growth of the foot is arrested to such a degree that complete fixation of this part in a position of abnormal plantar flexion results during the course of a few years.

There seems to be no good reason why with the exercise of time and patience the infantile pelvis may not be similarly molded in cases of vesical ectopia. Thus the mother may be directed to apply a snug and sufficiently wide rubber band around the child's pelvis and hips for some definite period during the day and night. If this be supplemented by operative division of the pelvic bones at the synchondrosis it may be possible to bring together permanently in this manner the two halves of the pelvis and to convert the transversely placed oval defect of the abdominal wall into a narrow vertical slit. This would produce practically the same conditions which are present in epispadias associated with a partial ectopia of the bladder and we should then

expect to have the same satisfactory operative result as in the less severe types of the deformity.

Cases of vesical ectopia are quite rare and their treatment demands the exercise of much time and patience. It is only by the united labors of many investigators that substantial progress can be attained.

Perhaps my brief communication may be the means of stimulating further research in this country on the lines indicated, which I have come to regard as the only method which is likely to be rewarded by perfect results.

CONGENITAL PROTRUSION OF HEART, STOMACH AND SPLEEN.

CASE OF CELOSOMA.

BY CARL HERMAN WINTSCH, M.D.,
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ACCORDING to Hirst and Piersol, celosoma is a lateral or median eventration with fissure, atrophy or even total absence of the sternum and protrusion of the heart.

The anomaly of disposition in such a case is undoubtedly due to the defective union of component embryonic parts; the direct cause undoubtedly being the adhesion of the amnion to the embryo. In the case reported below, the external cleft producing a sternal fissure and the absence of the entire sternum and part of upper ribs, was undoubtedly due to the abnormal volume of the heart causing a cardiac ectopia.

The imperfect union of the thorax was prolonged into the upper part of the abdomen, with the stomach and spleen protruding through the opening. Remarkable to note that at the point of entrance of the umbilical vessels, which is prone to incomplete closure, the closure was complete.

April 15, 1906, I was called to see Mrs. H., age 38, and delivered her of a living male child, normal in every respect excepting for a *complete protrusion of the heart, stomach and spleen*.

Family History.—Parents of the father are living and healthy. He is 35 years of age, healthy, and a tailor by trade. He is the third child of fourteen healthy children born unto his parents.

The mother's father died of apoplexy at the age of 58. Her mother is still living and healthy, and gave birth to seven healthy children.

This is the fourth child born unto Mrs. H., all healthy and living excepting one; ages of children $8\frac{1}{2}$, 7, $4\frac{1}{2}$ years. One year



FIG. 1.—Congenital protrusion of heart and stomach, anterior view.



FIG. 2.—Congenital protrusion of heart and stomach, lateral view.

and a-half ago the 7-year-old child, a male, was run over by a heavy truck, crushing in the entire chest, and died twenty minutes after the accident, in his mother's lap on the way to the hospital. The mother works hard every day helping her husband in the tailor shop, besides doing her own housework. During the pregnancy with this child the mother did not feel as well as she did when carrying her other children. She felt miserable and tired, and felt more life than with the rest of her children.

During her sixth month of gestation she stumbled over a board in the yard, and fell flat on her abdomen, but felt no ill effects from the fall. She says she had an enormous appetite and that the abdomen was much larger in circumference than with her other children.

Labor began at 2 P.M. on April 14; pains became severe about 7 P.M., and child was born at 2 A. M. April 15th. The child was born before I arrived; and the labor seemed perfectly normal, excepting a small hemorrhage just before the birth of the child. The child weighed 7 lbs. 1 oz. and measured 19 inches in length. Respirations were 30 in number; pulse 120-130; temperature 97.8°. It defecated and urinated normally. It became very cyanotic at times, which was aggravated when pressing upon the heart with the hand. The child lived two days and three hours and was fed per mouth with water and milk from breast of mother, which it retained. Just before death the child vomited a greenish fluid, and bled from its mouth.

The heart was moistened every 15 minutes by a saline solution 99° F. applied to gauze covering the heart. The heart was entirely on the outside of the body, covered by the pericardium. The systole and diastole were distinctly noticeable. The stomach and spleen were covered by the peritoneum.

The accompanying photographs (Figs. 1, 2) were taken instantaneously while the child was living, and the heart in full action.

As far as I am aware, from search through the literature, this is the only case on record of a full term living celosoma.

CHEWING-GUM NUCLEUS OF VESICAL CALCULUS.

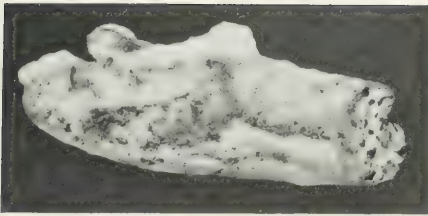
BY ED. B. KENNER, M.D.,

OF GALVESTON, TEXAS,

Formerly Demonstrator of Anatomy in the Missouri Medical College, and
Assistant in Surgical Clinic at the St. Louis Polyclinic.

USUALLY the peculiar psychopathic condition that impels a patient to introduce a foreign body into the urethra leads to secretiveness, but not so in this instance. The patient is a male, thirty-eight years old, a druggist by occupation and of fair intelligence. He applied to me immediately after the occurrence of the accident, now to be related, stating that he had been troubled for five or six years with a peculiar uneasiness in the deep urethra. He never had gonorrhœa or any bladder trouble, but six years ago had a fistula in ano, in the course of the treatment for which rectal bougies were used. This gave him the idea that something of the kind would relieve his urethral discomfort, so he had been using at intervals of every five or six months a piece of chewing gum on the end of a broom straw, which he would introduce into the urethra as far as the straw would go and then withdraw it; this he said would always relieve him of the peculiar feeling in the urethra. This chewing-gum straw bougie he had again attempted to use, but on this occasion the piece of gum had come off the straw when he attempted to remove it.

He was situated so that I could see him every day and not so that he could undergo an operation at once, so I explored the urethra and bladder with sound and cystoscope, and located the gum in the bladder and attempted to extricate it with a Bigelow's lithotrite, but only succeeded in breaking it into two pieces. One piece engaged in the urethra the next day and was voided with the urine during an act of micturition; the other piece remained in the



A piece of chewing gum showing calcareous deposits
after remaining in the bladder sixty days.

bladder for sixty days, without giving rise to any trouble, except to temporarily check the flow of urine at times. At the end of this period I opened the bladder from above the pubis, and removed the remaining piece of gum. It was covered with an abundant phosphatic incrustation as shown in the figure. An uncomplicated recovery followed.

DISLOCATION OF THE METATARSAL BONES.¹

BY LEONARD W. ELY, M.D.,

OF NEW YORK.

THE patient, an hotel porter, 45 years of age, presented himself at the Roosevelt Hospital Dispensary on February 10, 1906, and gave the following history:

One hour ago, while ascending on a freight elevator, standing on a trunk, he was caught by the left foot between the trunk and the edge of the side-walk. The foot was apparently flexed dorsally and compressed anteroposteriorly. The patient reached the dispensary with assistance.

Examination showed the heads of the second, third, and fourth metatarsals dislocated upward and outward on the dorsum of the foot, the head of the first metatarsal dislocated inward. The tarsus was, so to speak, shoved in between the metatarsals.

After a skiagram of the foot had been taken, the patient was shown by Prof. Brewer to his class, and was then anæsthetised. Under ether the dislocated bones could easily be replaced by pressure with the thumb, and could easily be re-dislocated.

A sole plate was made of plaster-of-Paris, running up behind the heel. This was strongly reinforced under the arch, and was prolonged on the internal aspect of the dorsum of the foot. To this splint the foot was tightly bandaged and strapped.

The splint was removed on February 21, and the heads of the metatarsals were strapped with adhesive tape.

Six weeks later the bones were in excellent position.

Stimson, in his book, mentions three cases of dislocation of the first four metatarsals, but in none of them was the displacement the same as in this case.

¹ Shown at the April Meeting of the Surgical Section of The New York Academy of Medicine, 1906.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, April 11, 1906.

GEORGE E. BREWER, M.D., in the Chair.

VANISHING TUMOR OF THE PYLORUS.

DR. HOWARD LILIENTHAL presented a man, 40 years old, who was admitted to Mount Sinai Hospital on February 5, 1906, in the service of Dr. Alfred Meyer. He was pale and emaciated, and had frequent attacks of vomiting. An inspection of the abdomen showed waves of violent peristalsis extending from the upper left side to the right iliac region. The abdomen was rigid. There was practically no temperature. A blood-count showed only profound anæmia. After an enema there was a fair movement of the bowels, with considerable gas, and the peristaltic movements ceased.

As the symptoms seemed to point to an intestinal obstruction, a small incision was made in the right iliac region, the place where the peristalsis seemed to come to a stop. Nothing abnormal was found there, but the palpating finger detected a tumor of the pyloric region, so a second incision was made higher up, which revealed a tumor of the pylorus fully as large as a duck's egg. It was freely movable, and was regarded as a carcinoma. The man's condition at the time was such that nothing could be done but a posterior gastro-enterostomy, which was completed by the suture method.

Sixteen days after the original operation, the patient's abdomen was again opened through the cicatrix of the upper

wound, with the intention of performing pylorotomy. During that brief period, however, the tumor of the pylorus had entirely disappeared. Not a vestige of it remained, and there was only the slightest suspicion of thickening around the pylorus. No treatment had been given in the interim.

DR. CHARLES N. DOWD said that several years ago he reported before the Society a case which was almost the exact counterpart of the one shown by Dr. Lilienthal, but that the subsequent history of this case was also worthy of attention. The patient, a young man, had all the signs of pyloric obstruction, with extreme emaciation. Upon opening the abdomen a firm tumor of the pylorus was found, about as large as a hen's egg. It appeared to be malignant, but on account of the patient's extremely weak condition a gastro-enterostomy was done, in the expectation of doing a pylorotomy at a later time. At the subsequent operation, however, no signs of the tumor of the pylorus could be found, and therefore the pylorotomy was not done. About eighteen months later the man died from perforation of the stomach, due to a diffuse cancer of the pylorus, and on autopsy all the tissues in the vicinity were found involved by cancerous infiltration.

Dr. Dowd said that it was difficult to explain these temporary pyloric tumors, but suggested that cedema which was due to the presence of an ulcer, or possibly a beginning cancer, must be an important element in their formation.

DR. ARTHUR L. FISK said that six years ago, he was asked to see a gentleman who was supposed to have cancer of the pylorus. The man was greatly emaciated, very feeble, and cachectic, and had a tumor in the epigastrium the size of an adult fist. The diagnosis was made by two of the best physicians in New York City, and the family were so informed. No operation was performed; the tumor gradually disappeared, and the man is living still, in excellent health, at the age of 84. Nothing can be palpated in the epigastrium which is suggestive of a tumor, or even thickening.

DR. GEORGE E. BREWER said that in Dr. Dowd's case the lesion was perhaps a pyloric ulcer, with the subsequent development of cancer. In connection with the cases that had been spoken of, Dr. Brewer said he wished to report a case of tumor of the sigmoid which, upon operation, he regarded as an in-

filtrating carcinoma. The condition seemed to be inoperable, and he limited himself to a colostomy. Eighteen months later the man returned to have his colostomy wound closed, and upon opening the abdomen it was found that the supposed carcinomatous mass had entirely disappeared. It was probably a gummatous tumor, as the patient subsequently gave a history of persistent headaches, which had disappeared under the use of potassium iodide.

DR. LILIENTHAL said that his patient had received no anti-syphilitic medication whatever after the operation. The mass at the pylorus might possibly be explained by assuming that the man had an ulcer, with a minute perforation and œdema, and the pouring out of an enormous quantity of lymph. The gross appearance of the mass, however, was certainly that of carcinoma.

As a possible aid in the diagnosis of these cases, Dr. Lilienthal said, the fact should not be lost sight of that large carcinomatous growths in the peritoneal region usually, though not always, invaded neighboring organs. If sufficient time had elapsed to allow the growth to attain considerable size, the probabilities were that there would be adhesions, and that adjacent structures would be invaded. In the absence of such manifestations, the malignant nature of the growth might be looked upon as doubtful.

ACUTE DIFFUSE SUPPURATIVE PERITONITIS.

DR. BENJAMIN T. TILTON presented a boy of 7 years, who, while being treated at the Willard Parker Hospital for scarlet fever, on the fourth day of that disease developed acute abdominal pain, followed by vomiting. He was kept under observation for twenty-four hours, and then transferred to Bellevue, the case being regarded as one of acute peritonitis.

At the time of his admission to Bellevue the abdomen was very much distended, with marked rigidity and tympanites, and general abdominal pain. The temperature was 102.8, pulse 130. The vomitus consisted of greenish material. An immediate operation was done, and on opening the abdomen in the median line, free pus was found throughout the peritoneal cavity. The appendix was found free from adhesions and not markedly enlarged. It was not removed. On the left side of the abdomen an abscess was found localized among

coils of intestine. The abdomen was irrigated and drained. The patient's condition was so bad that he almost died on the table. He was placed in the Fowler's position. Four hours after the operation the boy's temperature was 101.8; pulse, 142; respiration, 52. On the following morning his condition had remarkably improved, and from that time on the case went on to uninterrupted recovery. Five weeks had elapsed since the operation.

THE TREATMENT OF DIFFUSE SUPPURATIVE PERITONITIS FOLLOWING APPENDICITIS.

DR. LUCIUS W. HOTCHKISS read a paper with the above title (for which see page 197).

DR. JOSEPH A. BLAKE said the method of treatment of these cases, as outlined by Dr. Hotchkiss, was practically the same as that followed in his own work, and, so far as he knew, it was the best way. The speaker said he always inserted the drain into the peritoneal cavity, so as to carry off all excess of fluid. The work of Ochsner in this field of surgery was very valuable and instructive, and was confirmatory of Dr. Hotchkiss' method of treatment. Ochsner employed no drainage, and the diseased appendix was left in; if that organ was removed there was even less need of drainage. The modern tendency was to drain as little as possible, as it was well known that the introduction of a drain into the peritoneal cavity was fraught with great danger, and in the old days, when free drainage was resorted to, the patients almost invariably died.

The method of drainage recently suggested by Murphy, Dr. Blake said, was in some respects similar to the older form of treatment, its object being to remove the products of inflammation in the peritoneal cavity through an opening in the lower part of the abdomen. This to a certain extent did away with the necessity for the ordinary methods of drainage, but the same result of removing these products of inflammation could be accomplished by proper irrigation. The introduction of a certain quantity of hot saline solution into the abdominal cavity acted as a stimulant, but if continued for too long a time it was apt to produce shock. It should not be continued for over five minutes at a time. The amount of ether given these patients

should also be limited. After the peritoneal cavity had been cleansed as thoroughly as possible, a minimum amount of drainage should be employed, but if necrotic material had to be left behind in the abdomen, it should be isolated and drained.

Dr. Blake said that since he had used solutions of magnesium sulphate in the spinal canal, and had become better acquainted with the effects of the drug, he had felt less inclined to introduce it into the intestine following operation. In certain conditions it might fail to produce an evacuation, and by absorption might give rise to poisonous effects. He had recently heard of such a case in Boston.

Dr. LILIENTHAL said that at the outset it was important to define what constituted peritonitis. The mere fact that pus was occupying every crack and corner of the peritoneal cavity did not constitute a peritonitis. The presence or absence of other symptoms was important; namely, whether the tongue was dry or moist, whether there was paralysis of the intestine, whether the patient was clear in his mind, whether there was a septic nephritis, etc.

Discussing the anatomical phase of the subject, Dr. Lilienthal said it had appeared to him that the so-called diffuse peritonitis was a less serious condition than that form in which there were multiple abscesses throughout the peritoneum. He recalled one case, however, in which he opened five such abscesses with good result.

Dr. Lilienthal said that most surgeons were in accord that in the treatment of septic peritonitis the abdominal incision should be a small one, a minimum amount of the anæsthetic should be used, and the offending cause, if possible, should be removed. There was a difference of opinion as to whether the abdominal cavity should be irrigated or not. In one case, an irrigation continued for five minutes might prove a dangerous procedure, while in another irrigation for even a single minute would be contraindicated. Personally, the speaker said, he did not irrigate at all, no matter how much pus was there. He recalled one case where on opening the abdomen he found a gangrenous appendix, with an enormous quantity of free pus in the peritoneal cavity. The appendix was removed, and deep drainage introduced through the pelvis. The abdominal cavity was not irrigated, but with every inspiration there was a flow

of pus through the tube. The patient made a good recovery. Dr. Lilienthal said that in spite of the good results obtained by Dr. Blake and others who favored irrigation in these cases, he thought their results would be still better if they dispensed with irrigation. The speaker said he was formerly very enthusiastic in his advocacy of the value of irrigation, but now he was opposed to both irrigation and drainage, restricting the latter to those cases where the Fowler position was used, as there he thought the drain prevented the formation of secondary abscesses in the pelvis. With that one exception, and perhaps even without it, he was in favor of dispensing with drainage entirely, restricting himself to sewing up the greater part of the wound and putting in a drain just inside of the peritoneum—just enough to get rid of the overflow.

Dr. Lilienthal said it was the practice in his service at the hospital to take a culture from the free peritoneal fluid in these cases, and if the streptococcus was found, the case was regarded as a much graver one than were the usual forms of peritonitis.

DR. FISK said that Mr. Herbert J. Paterson, in his Hunterian Lecture, published in the London *Lancet*, March 3, 1906, discussed this very question, and advocated removing the cause of the trouble, sponging out the space behind and above the liver only, sucking out, with as little disturbance as possible to the intestines, any fluid in Douglas' cul-de-sac, and establishing early intestinal peristalsis.

Dr. Fisk said that among the earlier cases of this kind that were operated on at the Massachusetts General Hospital, when he was an interne there, irrigation was done hourly for many hours, and most of the patients died. The speaker said he had entirely discarded irrigation; that he now removed the appendix, very gently but thoroughly dried out the pelvis with gauze sponges wrung out in warm salt solution, and then inserted a cigarette drain to the stump of the appendix. The results of that method had thus far been very satisfactory. The Fowler position was maintained for some days.

DR. HOTCHKISS said the entire discussion centred about one point, which was the logical crux of the situation, and that was, whether irrigation of the peritoneal cavity was beneficial or harmful? Whether it was wise in these extensive cases to remove, by irrigation, part of the highly albuminous exudate,

which was relatively slow of absorption, and replace it by saline solution, which was more rapid of absorption? The insertion of a drainage tube into the pelvic cavity of course removed the pus that was there at the time, but in the course of a very few hours, the drainage would be closely limited by adhesions and we could not drain the peritoneal cavity within.

Personally, Dr. Hotchkiss said, he did not regard the irrigation as all important. There is bound to be considerable difference of opinion among surgeons as to the method of treating these cases. If we could safely omit the irrigations, well and good. It had been demonstrated in his own experience that we could omit drainage, if we would wash out some of the purulent fluid. Whether both drainage and irrigation could properly be omitted in some of these cases was still an unsettled question.

DR. LILIENTHAL asked Dr. Hotchkiss whether he would resort to drainage in a case of peritonitis, with free pus in the peritoneal cavity and a necrotic abscess surrounding the appendix? Personally, he thought that such an abscess should be drained. He was willing, however, and he intended in his future cases to omit pelvic drainage; he was inclined to agree with the reader of the paper that irrigation was nothing more than one form of drainage.

DR. HOTCHKISS, in reply to Dr. Lilienthal, said that if there was a localized necrosis which could not be removed, it should be packed until it came away. In cases where the gangrenous appendix could be removed, entirely and cleanly, he did not drain at all.

DR. HOTCHKISS said it was generally agreed that at least a great part of the exudate in these cases was the result of a conservative process on the part of nature to repair the damage that had been done, and it was not only wise to retain it there, but it was impossible to entirely wash it away. By rapid irrigation, he thought we washed away some of the highly albuminous purulent fluid, which was slow of absorption, and sometimes harmful, and replaced it by a weaker solution, which was more rapidly absorbed.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, held April 2, 1906.

The President, JOHN B. ROBERTS, M.D., in the Chair.

TRAUMATIC INTUSSUSCEPTION.

DR. FRANCIS T. STEWART reported the case of a man, aged 30 years, who was struck just above the crest of the left ilium by a heavy steel beam. Shortly afterwards he was admitted to the Germantown Hospital in the most profound shock. At the end of 20 hours his temperature had risen to normal and the pulse had fallen to 110. He had vomited twice and passed 12 ounces of bloody urine. There was great pain all over the abdomen, a large hæmatoma in the left loin, and intense rigidity of the abdominal muscles. Liver dulness was decreased by three finger-breadths, and no dulness could be detected in the flanks. The abdomen was opened in the middle line below the umbilicus and a large extraperitoneal extravasation of blood found extending from the bladder, whose walls were infiltrated with blood, to the left kidney, which was normal to palpation. The abdominal muscles on the left side were torn from the left iliac crest. The peritoneal cavity was opened and found to be clean; there was no visceral rupture. In numerous places the small intestine was tightly contracted, the areas involved varying greatly in extent, so that in certain regions the intestine seemed to be ligatured, while in others it resembled a piece of tape. In one place the contracted intestine had passed into

the relaxed segment below for a distance of two inches. The intussusception was reduced, the peritoneal cavity closed and the extraperitoneal tissues drained. The patient died four hours later of shock.

Dr. Stewart observed that every surgeon has probably been struck by the tetanic contraction of portions of the intestine in traumatic cases, and has conceived the possibility of a traumatic intussusception, but of this there is no record. Attention, however, has been called to the fact that this muscular contraction may prevent the escape of intestinal contents for some days, even when the bowel has been completely divided. In some cases areas of dulness due to the contraction of large segments of bowel may be detected before operation. It may be that in some cases of transient intestinal obstruction after laparotomy for nontraumatic conditions the lesion is a spastic stenosis due to the necessary violence of the operation.

DR. ROBERT G. LE CONTE briefly described a case he had seen eight years ago which resembled in many points the one reported by Dr. Stewart. A boy of nine was stabbed in the left side of the abdomen, the wound penetrating to the peritoneum, as shown by omental protrusion. Under ether the abdomen was opened and a careful search of the intestine did not reveal any injury. Considerable hæmorrhage had taken place into the abdominal muscles, and also in the peritoneal cavity, from some large vessel which had been severed in the rectus muscle. While searching the intestine for a wound a direct intussusception about an inch long was found about the middle of the small gut, and two or three feet lower down two more were found, one direct, the other retrograde, each about three-fourths of an inch in length, while the sheath or intussusciens covering them was probably two inches in length. These intussusceptions resembled in appearance the kind so frequently observed at post-mortem examinations. There was no sign of inflammation, no congestion or change of color in the gut or mesentery, the peritoneal coat was normal in appearance, and reduction was accomplished with very light traction. Treves, in his work on intestinal obstruction, divides invaginations into two great forms, according to the circumstances of their origin: (1) The common or obstructive intussusception, and (2) the intussusception of the dying.

The latter form he attributes to certain irregular peristaltic movements which may be conceived to occur during the act of dying, either from changes in the circulation or from irregular stimulations of the vagi nerves. Such intussusceptions may form many hours after death, as is well illustrated in the case of Rurah (Archives of Pediatrics, April, 1896). While making an autopsy twenty hours after death on the body of an infant he saw an intussusception of the ileum form, and on handling the intestines other portions of the ileum began to invaginate themselves, so that in a few moments the entire small gut had become a mass of intussusceptions varying from 5 cm. to 10 cm. in length.

In the case reported by Dr. Stewart, and in his own, the intussusceptions present resembled in all particulars the so-called moribund invagination, and not the obstructive intussusception.

Three theories present themselves as a possible explanation:

1. The mechanical injury to the abdomen (the blow).
2. Hæmorrhage which may produce local changes in the circulation of the intestine or irregular stimulation of the nerves controlling peristalsis.
3. Opening the abdomen and handling the intestines while searching for the wound. This latter would seem the most probable cause.

GALL-STONES WITH ACUTE SUPPURATIVE PANCREATITIS.

DR. STEWART related the case of a man, aged 51 years, who had suffered with attacks of indigestion for many years. February 25, 1906, he entered the Pennsylvania Hospital in the service of Dr. Le Conte. He had been ill for three weeks with severe epigastric pain, particularly after eating. There had been no vomiting or jaundice, but the temperature fluctuated irregularly, sometimes reaching as high as 103°. The epigastric muscles, especially on the right side, were rigid, and Dr. Thornton, who had had charge of the case, thought that at a previous examination he could feel an indefinite mass; he advised operation, believing the patient to be suffering from cholecystitis, with possible involvement of the pancreas. The urine was normal. At operation the gall-bladder was found tensely distended, the common duct unobstructed, and the pancreas

hard, lobulated and several times its normal size. There were no adhesions, and the stomach and duodenum showed no pathological change. The gall-bladder was opened and drained; it contained three large gall-stones and a mixture of bile and mucus which proved to be sterile. The cystic duct was filled with a quantity of a sand-and-putty-like material. Two days after operation the patient became slightly jaundiced, and between this time and the second operation he had three chills. The tube drained between one and two ounces of muco-bile during the course of each twenty-four hours. The bowels moved regularly and were always colored. On the eleventh day the abdomen was opened through a separate incision to the outer side of the original incision, which had become infected. The pancreas seemed to be in the same condition as at the previous operation. Some sandy material had lodged in the distal end of the cystic duct and could only be removed by excising a portion of the duct. A probe passed into the hepatic duct and down in the common duct revealed no obstruction, and these ducts were empty and collapsed. The patient died three days later, the jaundice becoming more intense, but the fever not recurring. At the post-mortem no obstruction was found in the ducts, but the head of the pancreas contained an abscess cavity holding perhaps two ounces of pus, which proved to be caused by the colon bacillus. There was a septic phlebitis of the portal vein and miliary abscesses in the liver. The remaining abdominal organs and the heart and lungs were normal. Quénu and Duval have collected 118 cases of pancreatitis coexisting with cholelithiasis. Of 104 cases in which the seat of the stones was stated, in 56 the common duct was involved, while in 46 the calculi were in the gall-bladder or cystic duct. A study of the relation of the location of the stones to the variety of pancreatitis shows that the chronic form is most frequently associated with lithiasis of the common duct, the suppurative form with calculi in the gall-bladder, and the hæmorrhagic variety with stones in the ampulla of Vater. In 72 cases there was a history of infectious or retention jaundice. Of the 118 cases, 20 were hæmorrhagic, 27 suppurative, 63 chronic, one cyst of the pancreas, and 7 reported as pancreatitis without any other epithet. In the great majority of the acute cases the process was localized to the head of the gland. Abscess of the lesser per-

itoneal cavity and phlebitis of the splenic or portal vein were common. In 20 cases there was a disseminated fat necrosis.

Pancreatitis developing in the course of biliary lithiasis is generally regarded as a complication. The relation is easily explained when the common duct is involved. The infection spreads by contiguity to the head of the pancreas, by continuity along the pancreatic duct, or it invades the intrapancreatic lymph-glands. Obstruction at the duodenal papilla may cause pancreatic stasis and regurgitation of infected bile, while a stone lodged in the pancreatic segment of the duct may compress the canal of Wirsung and lead to pancreatic retention, thus predisposing to infection. The passage of a stone by dilating the ducts favors an ascending infection from the duodenum, the contents of which are rendered more septic by the absence of bile. There is no satisfactory hypothesis for the occurrence of pancreatitis in cases in which the stones are lodged in the gall-bladder. Desjardins suggests that the initial infection in these cases is an ascending one which causes cholelithiasis and pancreatitis contemporaneously. Probably in some cases there is absolutely no relation between these two affections. The operative mortality in five hæmorrhagic cases was 100 per cent.; in 16 suppurative or necrotic cases, 50 per cent., and in 62 chronic cases almost 13 per cent. In acute cases the pancreas should, of course, be drained. In the case reported above, the induration felt at the time of operation was thought to be due to chronic inflammation, and this may have been true, the suppuration occurring subsequent to the cholecystostomy. The same course was taken in five of the 21 operations for acute pancreatitis reported by Quénu and Duval, with death in each instance.

SARCOMA OF THE OVARY.

DR. STEWART related the case of a woman, aged 31 years, who was admitted into the Polyclinic Hospital, February 26, 1906. About two years ago the patient noticed a small, painful lump in the right iliac region. The tumor gradually increased in size until at present it almost fills the abdomen. There are irregular attacks of sharp pain which have been so severe during the past two weeks that the patient has been

unable to work. The menses began at twelve, are always regular, and last from two to three days; they are more painful but no more profuse since the lump was noticed. There has been no loss of weight or symptoms referable to the digestive or urinary apparatus. The tumor is hard, smooth, symmetrical, and slightly movable with the respirations and on pressure. Pulsation and bruit are quite distinct over the whole growth. There is no cedema of the legs. There is a patch of tympany behind the tumor in the left flank, and dulness in the right flank, giving way to tympany when the patient turns on the left side. The growth was removed through a median abdominal incision about eight inches in length. There were no adhesions and but little fluid in the abdominal cavity. The pedicle attached to the right horn of the uterus was about three inches in diameter. The left ovary, which was about four inches in diameter and cystic, was also removed. At each point where the aneurism needle had been passed through the pedicle of the tumor there was free bleeding. An attempt was made to control this by sutures, but each additional needle puncture also caused bleeding, so that a piece of gauze was pressed against the bleeding points and allowed to remain in place. The patient suffered little shock and reacted promptly without vomiting. At the end of thirty-six hours she quietly began to regurgitate stercoraceous material. Under ether the gauze was removed and a slight kink in the bowel straightened; this did not appear, however, to be sufficiently great to produce obstruction. The patient did not vomit for the succeeding twelve hours, at which time the stercoraceous regurgitation recurred. There was no pain, no fever, and no active peristalsis, although the bowels moved once by enema. The incision was reopened and the entire intestinal canal found moderately distended and motionless. There were no evidences of peritonitis or obstruction. An artificial anus was established by anastomosing a rubber tube to the bowels by means of a Murphy button, but there was absolutely no drainage from the tube until the time of death, which occurred twenty-four hours later. The lesion was probably an intestinal paralysis caused by the sudden relief of long-continued pressure.

The tumor weighs 2830 grammes. Microscopic diagnosis, round-celled sarcoma. Left ovary, angiosarcoma.

PERFORATING TYPHOIDAL APPENDICITIS.

DR. JOHN B. ROBERTS reported the case of a boy of nine years, who was admitted to Dr. James Hendrie Lloyd's ward of the Methodist Hospital on January 5, 1906, with symptoms of typhoid fever. The illness was said to have begun seven days previously, when he went to bed with severe headache, but he had had no nose-bleed or pain in the back. There was no cough, and no diarrhoea. When he was admitted to the hospital his tongue was coated; temperature 104° ; respiration 26; pulse 108. The abdomen was flaccid, showed no rose-colored spots and was not tender on pressure. The blood obtained on the day of admission gave a positive Widal reaction, and on January 7th rose-colored spots appeared on his abdomen. His urine showed a specific gravity of 1020, contained no albumen or sugar, and gave the diazo-reaction. The white blood-corpuscles numbered 5600. The hæmoglobin was 80 per cent. The heart and lungs and other viscera showed nothing special, except that the spleen was palpable.

On January 8th the general condition of the patient was good. There was no pain or tenderness in the abdomen. The morning temperature was 102° ; pulse 96; respiration 24. In the evening the temperature rose to 104° , with pulse 120 and respiration 24.

In the early morning of the 9th, the patient, after being sponged, complained of pain in the abdomen, and a little later had a distinct chill. His temperature dropped to 100.6° , but subsequently rose to 103° , which was followed by free perspiration and a rapid drop during the evening, until at midnight the temperature was 98° , with pulse 110; respiration 24. During the time of this fall of temperature the patient had marked diarrhoea, with a large amount of mucus, but no blood. The pulse was not altered very much in frequency, but during the period of perspiration the patient seemed weak and the pulse varied somewhat in quality. The patient looked white, and vomited. A blood examination made at midnight by the resident physician, Dr. L. L. Powell, showed 44,480 leucocytes. At 3 A. M. of the 10th the patient's temperature was 97.8° , though the pulse was only 104 and the respiration 24. The patient's facial expression was bad, and there was pain in the abdomen, with marked tenderness, and with rigidity on the right

side. Symptoms of perforation seemed sufficiently positive to warrant operation; and Dr. Roberts opened the abdomen about six o'clock in the morning, making an incision 6 cm. long, through the right rectus 2 cm. to the right of the umbilicus, beginning 3 cm. below the level of the umbilicus. The incision ran obliquely downwards and toward the middle line. On opening the peritoneal cavity a small amount of pus was found, but no fæces, among the intestinal coils. It was rather thick and did not have the colon-bacillus odor. The appendix was somewhat swollen and congested, and showed a small perforation near its junction with the cæcum. The lower three feet of the ileum were inspected, but no perforation was found. The peritoneum of the intestine did not show any discoloration to indicate where the inflamed Peyer's patches were situated. There was no marked congestion of the intestine, and no enlarged mesenteric glands were seen. The cæcum and the first eight inches of the large bowel were examined, but showed nothing abnormal. There were no adhesions about the appendix or the examined intestines. The perforated appendix was excised, and the stump touched with carbolic acid and dropped into the abdomen. A large rubber drainage tube was inserted in the iliac fossa and iodoform gauze placed around it in the wound. Examination of the pus removed from the abdominal cavity showed a few diplococci.

The child's temperature remained at about the normal point for some thirty hours after operation, then began to ascend in a characteristic typhoid-fever curve. A blood examination made the evening of the day of operation gave the positive Widal reaction and showed a leucocytosis of 17,760. The drainage tube was pumped out by means of a syringe every few hours at gradually longer intervals and was finally removed on January 21st. A leucocyte count on January 16th showed that the number of leucocytes had decreased to 7,650. For two or three days after operation there was considerable abdominal distention, which was relieved by enemata of asafœtida. The patient convalesced without interruption, and on February 28th was discharged from the hospital.

Dr. Roberts said that it was well established that the appendix is very frequently the subject of pathological changes during the course of typhoid fever; and that these lesions are

similar to those found in the lymphatic structures of the mucous membrane of the rest of the intestine. This may with propriety be termed typhoidal appendicitis. Then there are cases of typhoid fever in which appendicitis occurs from pyogenic infection, just as it may in healthy persons. Kelly and Hurdon discuss these conditions with great fullness. Deaver also devotes much attention to appendicitis coincident with, and caused by, typhoid infection.

In the matter of treatment these authorities are practically in accord. They believe that appendicitis developing in the course of typhoid fever does not call for operative treatment unless the symptoms are urgent. The access of symptoms of perforation or other grave accident demands prompt surgical interference, in their opinion; but otherwise an expectant policy under surgical supervision is advocated. When surgical intervention is evidently needed, it is to be adopted promptly and carried out with celerity.

VOLVULUS OF THE SMALL INTESTINE IN TYPHOID FEVER SIMULATING PERFORATION.

DR. JOHN B. ROBERTS read a paper with the above title (for which see page 242).

DR. GWILYM G. DAVIS took exception to Dr. Roberts's statement that perforation of the appendix is more fatal than is perforation of the intestine in typhoid fever; the mortality of the former is generally placed at 50 per cent.; that of the latter, 75 to 80 per cent. One would naturally expect this difference, because if there is a typhoid ulcer of the appendix the patient is very sick of typhoid *per se*; if the appendicitis is separate, then the patient so far as the typhoid is concerned may be in good condition. Then again the appendix is situated at one side of the abdomen and toward the posterior wall, and is at least partly covered by intestines. For these reasons extravasated material from this organ is less apt to extend widely. In typhoid fever the perforation is usually at least a few inches or a foot from the ileocæcal valve, if not in the middle of the abdomen. The fæcal material passes out among the coils of the intestine, adhesions do not form, and general peritonitis is the result. Intestinal contents are more often poured out from

typhoid perforation, as fæces are not commonly found in the cæcum.

DR. JOHN B. DEAVER said he had had some experience with perforation of the appendix during typhoid fever and had successfully operated on cases of this type. Recently he saw a case in which perforation of the appendix and of the intestine both occurred. The condition of the patient was such that operation was not advised, and death soon followed. Autopsy showed a perforation of the appendix and also one of the ileum at a point six inches above the ileocæcal junction. It is generally proved bacteriologically in these cases that the appendicitis is typhoidal in origin. Dr. Deaver has seen but little of intestinal obstruction during typhoid fever. Recently he operated on a case of intussusception, the diagnosis of which was made by an observant resident physician (Dr. Becker) at the German Hospital. The patient was a woman in the third week of typhoid fever, in whom there developed abdominal pain, shock and fall of temperature. She had not the pronounced rigidity which is so characteristic of perforation. Operation revealed an intussusception of the ileocolic variety, including the ileum for four inches above the ileocæcal valve. It was easily reduced, and in so doing there was exposed an ulcer the size of a quarter. There were also ulcers in the ileum. The patient is now convalescing. Dr. Deaver regards the second case of Dr. Roberts as one of volvulus which was reduced by manipulation.

DR. JOHN H. GIBBON said the cases reported by Dr. Roberts emphasize the fact that one should operate during typhoid fever if the symptoms warrant it, even though the condition does not suggest perforation. Medical men want the surgeon to assure them that perforation has occurred before they consent to operation. This assurance cannot in all cases be given. The point is that in all cases with pronounced symptoms operation is warranted; if perforation be not found, usually some condition demanding interference, as in the cases of Dr. Roberts, will be present. Dr. Gibbon has operated on two cases of appendicitis during typhoid fever. In one, three ulcers were present, blocking the appendix and causing all the symptoms of appendicitis with an abdominal crisis. The physician asked if he was sure of perforation, and was told no. Operation was then refused, but permission was finally obtained after insisting that the

symptoms warranted opening the abdomen. Dr. Roberts's cases show that one should open the abdomen if the symptoms warrant it, even with the lack of a definite diagnosis.

DR. WILLIAM J. TAYLOR has operated on two cases of appendicitis occurring during typhoid fever, but operated before the appendix perforated; both patients recovered. He believes that when abdominal symptoms in cases of typhoid fever lead one reasonably to suppose there is appendicitis, then he should operate. Both of his patients were benefited by the operation. He intends continuing the use of this method of treatment.

DR. GWILYM G. DAVIS said that he did not mean to suggest that Dr. Roberts's case was one of typhoid perforation of the appendix. He has operated on one case of perforation of the appendix during typhoid in which there was also an additional intestinal perforation present.

DR. RICHARD H. HARTE regards Dr. Roberts's experience as emphasizing the old statement, "When in doubt, operate." There are so many complications during and after typhoid fever that we are led to regard numerous cases as doubtful; this is because no one can tell what is going on within the abdominal cavity. In many cases distinction is not possible, and the surgeon really can only guess what is the lesion; in all these cases operation should be performed. It is a wonder that there are not more cases of volvulus during typhoid fever than are reported, but it is not a common condition. By his colleagues present at this meeting at least one hundred cases of typhoid perforation have been operated upon, the greater number of which were diagnosed before operation, yet Dr. Harte ventures the assertion that among them was no case of volvulus. There are many curious conditions in typhoid fever. In some cases there is a great deal of abdominal rigidity, though in many of these there is no perforation. Cases in which there is sudden onset of abdominal pain, with tenderness and rigidity and a peculiar facial expression, are very important as indicating perforation. In all doubtful cases it is wise to open the abdomen, as this procedure does not materially affect convalescence. Of the 26 cases Dr. Harte has thus treated, two had no perforation, but both patients made satisfactory recoveries. As a sequel of typhoid fever, some cases present, a few months or a year afterward, marked peritoneal irritation, probably due to cicatricial

contractions. Where the intestine has been studded with ulcers there must necessarily be a great deal of contraction. As a rule these patients die, but a few recover, and these later present curious symptoms of partial obstruction, which is frequently relieved by the intelligent use of purgatives.

DR. GEORGE ERETY SHOEMAKER said that definite localizing symptoms indicating the presence of an acute disabling lesion call for operation during typhoid fever just the same as at any other time. He has operated for appendicitis in one case during typhoid and the patient recovered.

DR. FRANCIS T. STEWART has operated on several clear cases of appendicitis during the course of typhoid fever, and upon three other cases illustrating the possible findings in cases of like character. One was regarded as typhoid perforation of the appendix, there being in that organ a punched-out ulcer from which fæces were oozing. Recovery. In the second a diagnosis of perforation was made, but operation showed suppurative peritonitis and no perforation. The patient recovered. The third case was diagnosed appendiceal abscess in the course of typhoid fever; operation revealed an enormous mass of mesenteric glands below the cæcum. The peritoneum was clean, and there was no pus in the glands. The patient died of typhoid toxemia at a later period.

DR. ASTLEY P. C. ASHHURST said that there appeared to be no question that appendicitis is a much less severe condition during typhoid fever than is intestinal perforation. Some patients recover from the appendiceal lesion without operation, and practically all with unoperated intestinal perforation die. Patients who develop appendiceal symptoms during the early stages of typhoid fever usually recover whether operation is performed or not; but during the height of the typhoid fever both statistics and experience show that it is best to postpone operative interference unless it is very certain that the appendix is perforated or that peritonitis has occurred without actual perforation. Dr. Ashhurst had in mind now the case of a child, recently seen, who was suddenly seized with abdominal pain and vomiting. No clear history was obtainable, but in addition to extreme tenderness over the appendix there was high fever and slow pulse. The fever was too high and the pulse too slow to be typical of appendicitis, so the girl was sent to the Penn-

sylvania Hospital with a diagnosis of typhoid fever. The course of the disease was long and severe, the child being in the hospital ten or twelve weeks, but finally recovering. It seems probable that typhoid lesions in the appendix caused early irritation, and that recovery would have followed operation early in the attack, just as it did although no operation was performed. The case of intussusception during typhoid fever, included in the statistics published by Dr. Harte and the speaker, and referred to by Dr. Roberts, was one of the Episcopal Hospital cases operated upon by Dr. Hutchinson. The intussusception was gangrenous and irreducible, and a resection of the gut was therefore done, with circular enterorrhaphy; but the patient was too ill to stand the shock of the operation and died shortly afterwards.

DR. ROBERT G. LE CONTE said it must be remembered that the diagnosis of an acute abdominal crisis in the course of typhoid fever is often uncertain, particularly in the third and fourth weeks of the disease, when the patient is markedly adynamic with either stupor or delirium. Under such circumstances the three cardinal symptoms of peritonitis,—namely, pain, localized tenderness and rigidity,—are often absent, and few of the secondary symptoms may be present, such as changes in temperature and pulse rate, vomiting, distention, dullness in the flanks, etc. In these cases the surgeon cannot make a diagnosis of perforation at his first visit, for the symptoms present are so masked by the toxemia of the patient, or come on so insidiously, that an exact diagnosis is not possible.

Dr. Le Conte then briefly detailed two cases.

The first, seen about two weeks ago, was a woman of twenty-five in the fourth week of typhoid fever. She was delirious, picking at the bed-clothes, and profoundly toxic. The abdomen was distended and tender, but there was no rigidity, and no pain was complained of; no change in the temperature or pulse-rate, and the ear could not detect signs of peristalsis in the abdomen. An immediate operation revealed perhaps more than a quart of pus in the abdominal cavity, which was free from adhesions.

The second case, seen to-day, was a boy of seventeen, in the nineteenth day of his illness. He was profoundly stuporous and toxic. The abdomen was distended and rigid, with

some tenderness; no change in the temperature or pulse-rate. The attending physician had diagnosed perforation. In consultation with Dr. Harte it was agreed that an exploratory incision should be made, but that the diagnosis of perforation was doubtful. The abdomen was opened and no sign of peritonitis was present.

Both cases were markedly distended, and in neither was there any alteration in the temperature or pulse. The one with peritonitis had tenderness but no rigidity, while the other was rigid without any mark of tenderness. These cases illustrate the difficulties of an exact diagnosis at the first visit, and yet in both an immediate operation was deemed advisable.

DR. ROBERTS, in closing, said he was indebted to Dr. Davis for calling attention to his erroneous verbal statement in regard to the comparative mortality of perforation in the appendix and the ileum in typhoid fever. The statement was not contained in his paper, but was made during the introductory remarks. He rather feels that appendicitis, if it be not true typhoidal appendicitis, should be operated on in typhoid patients with pretty much the same urgency as in appendicitis occurring in patients not suffering from typhoid fever. A carefully-performed operation in competent hands, with proper surroundings, will probably not influence unfavorably the course of the enteric fever. It may even be done under local anæsthesia, if general anæsthesia is considered unwise.

ON THE USE OF THE MASLAND SAW FOR OPENING THE CRANIAL VAULT.

DR. H. C. MASLAND read a paper with the above title (for which see page 161).

DR. M. H. CRYER said that about 1891 a circular saw was devised with various guards to regulate the depth of penetration, also with an underguard which would pass between the dura-mater and the inner plate of the bone, thus dissecting the membrane from the bone and preventing the saw from cutting it. This instrument with an upper guard was used by him in helping Dr. W. W. Keen to open the brain-case for the removal of the Gasserian ganglion on October 18, 1893. The following is a quotation from Dr. Keen's report of the case: "An omega-

shaped incision was made the length of which vertically was three inches; one leg terminated in the front of the tragus, the other just in front of the junction of the anterior and middle, third of the distance between the auditory meatus and the external angular process. The temporal artery was cut, and that and a few vessels required ligation. Dr. M. H. Cryer, with a surgical engine of S. S. White Co., and a circular saw one and a-half inches, with guard, then rapidly and very successfully divided the external table excepting at the two extremities."

On receiving the invitation to discuss Dr. Masland's paper, Dr. Cryer went to his instrument morgue and resurrected this instrument spoken of by Dr. Keen as doing the work "rapidly and successfully." Tied to the instrument is another upper guard so arranged that the blood would not be thrown upwards. There are also two lower guards with it, intended to dissect away the dura and at the same time prevent the saw from cutting it, all of which is quite similar in principle to those described by Dr. Masland.

Although the circular saw with its upper guard worked fairly well, Dr. Cryer was not satisfied with it, as he felt that for his use an instrument must be made that would cut any thickness of skull in straight or curved lines without withdrawing the osteotome, and with great rapidity and absolutely no damage to the dura-mater. A guard therefore must be made to work on the inner side of the skull, and must be capable of turning on a very short curve without catching or tearing the dura. As such an instrument had been thought of at the time of the Keen operation, it was but a short time afterward that the one known as the spiral osteotome, with its underguard, was devised and used by others as well as himself. This cutting instrument has been spoken of as a drill by Dr. Masland. This is quite a mistake, as a drill is known to mechanics as an instrument for drilling a hole, usually in hard substances such as stone, metal, etc. The instrument in question is not a drill, as it would be impossible to drill or even bore a hole with it. It is as absolutely a side cutting instrument as any saw could be; in fact, in one sense it is a circular saw with three teeth or spiral blades cutting in the line of its shaft instead of at right angles. The instruments were presented. There are three hand-pieces which are all interchangeable with the instru-

ments. In one hand-piece there is a very small trephine for making the initial opening if so desired; in another a spiral osteotome with its guard which cuts a kerf about one-eighth of an inch in width. In the third a spiral osteotome which is somewhat finer and cuts a less track. A still finer one can be used. This instrument is the ideal one to the speaker for opening the brain-case. It may not be for others, as to a certain extent each one should judge for himself, as every man ought to use the instrument with which he knows he can do the best work. But apart from the advantage of having a person use the instrument to which he is most accustomed, the best appliance is undoubtedly that which is so constructed that it can be used successfully by the greatest number of men and do its work well under the greatest variety of circumstances. For this reason the younger surgeons should adopt the use of the most modern and efficient instruments that are presented to the profession.

The circular saw, driven by a light spiral cable for craniotomy, has inherent defects. The cable does not give a steady motion, it is liable to have what is known as "back-lash," and will chatter if the saw becomes the least bound or if a greater force is suddenly required. The saw cannot be used in making a curved incision when cutting the full depth of bone. It has to be lifted out for each change of direction, and will make an ugly cut at corner. It cannot be regulated by an upper guard to the varying thickness of the skull that is being cut. An underguard, if properly constructed, would allow any varying thickness to be cut, but an extra opening would have to be made by a trephine or the mallet and chisel to allow the entrance of the guard for nearly each direction cut. This would take considerable time. For these reasons he had long ago discarded the use of the ordinary circular saw with its upper and lower guards.

DR. THOMAS C. STELLWAGEN said he did not question the efficacy of the instruments of Drs. Masland and Cryer in their own hands, but personally he had tried them and found that special training was necessary for their use. This is especially needful to avoid injury to the brain and to the middle meningeal artery. None of these instruments can be thoroughly controlled, and to use them safely the surgeon must be trained by many

operations on the cadaver and by using the instrument every day. The Masland saw is difficult of sterilization when oil is being slung from it, as is constantly done. As to beveling the edge of the bone, this is not necessary. In a number of cases the bevel is not of great advantage. Another point is that the external table and diploe should be sawed and the internal table broken with a chisel instead of being sawed through as is done with these instruments. It is impossible to saw through the inner table without injuring the dura unless the operator is perfectly trained. None of these special instruments, including the one devised by himself, is being used by surgeons, because they have not time to perfect the use of the device.

DR. GWILYM G. DAVIS saw a year ago an instrument devised by Dr. Codivilla, of Bologna, which very closely resembled that of Dr. Stellwagen. As to the general question of surgical engines, they may be used to bore holes and they can be used with burrs, trephines and saws, as shown by the demonstrators. He became interested in the matter some years ago, and found that for boring ordinary holes the engines are admirable. There is some difficulty in sterilization and in other points, but these give no special trouble. When it came to using burrs he found he could obtain better and quicker results with a mallet and gouge. With the trephine he used the engine in an intracranial neurectomy case. A guard was carefully applied, and he practised diligently on the dead body until he could cut just to the dura-mater without injuring that structure. On the patient, although he was more careful than with the cadaver, the trephine cut entirely through and brought up the dura with the bone. The patient died of meningitis. He then tried opening the skull with saws, but found it difficult to get saws that would work. Guards were made for the saws, but this method was finally abandoned because it was necessary first to make a trephine opening and also because the guards, in order to work, were so thin that they were liable to perforate the dura. It was desirable that the saws should cut a circle, and he had saws made for this purpose, but a guard could not be used with them and there was a tendency to jam. This latter fault is common to all these mechanical saws. His engine is now in the anatomical laboratory and he concludes they are all of little practical value except Dr. Cryer's method of first open-

ing the skull and using his recently perfected fine cutting osteotome. In his work he prefers a gouge instead of an engine. The bevel of the gouge should be on the under side, however, instead of upper, as they are commonly made.

DR. JOHN B. ROBERTS said that he had long been interested in improvements in methods of opening the skull. Some twenty years ago he had suggested and experimented in making openings of various shapes in the skull by means of a flat burr driven by the dental engine. This was before surgeons knew that osteoplastic cranial flaps were practicable, and that pieces of bone could be replaced in the trephine opening with the probability of retaining life and closing the opening. He published a paper on this subject at that time in the *Philadelphia Medical Times*. Subsequently he had devised an aseptic trephine, which has been a good deal used, and also invented a segment trephine for removing a button when the thickness of the skull varied very much in different parts of the circle to be removed. At the present time he feels a little inclined to agree with Dr. Davis in the opinion that many of the modern devices driven by electric motors are too complicated to be employed in occasional operations. They are, however, undoubtedly valuable in large hospitals, where they can be kept in order and where they will be frequently needed.

DR. CRYER, in closing, stated his preference for the straight barrel trephine for making the initial opening, which, if held perpendicularly to the skull and with the hand resting upon the skull, can be accurately manipulated. It takes practice to use it properly; then one can use the instrument without injuring the dura. He showed another instrument which stops when it passes through the bone, and no amount of pressure will make it go deeper, as it is made to choke when it passes through the hard tissue. In all delicate surgical operations he prefers the "cord" engine, because it runs without vibration or "back-lash," the hand-piece carrying the cutting instrument can be carried in any direction without moving the engine, and if the cutting instrument is caught the cord will slip and practically no harm be done. One disadvantage with instruments of the type shown by Dr. Masland is that the hand-piece being fastened to a comparatively rigid shaft, the operator cannot cut the various sides of the flap without moving the entire

engine, which would be very inconvenient, besides impracticable in actual surgical work.

DR. MASLAND, in closing, said that the back-lash of the dental cable is prevented here by dispensing with the flexible wrist connection, and using a heavy cable. The attendant who has charge of the motor can at the same time gently support the cable, and so prevent any drag it might otherwise have on the saw. The cable is superior to the belt in that both cable and sheath can be sterilized, whereas with the belt we have an unsterilizable and rapidly moving belt and gear in immediate proximity to the seat of operation.

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ORIGINAL MEMOIRS.

THE SERUM THERAPY OF TETANUS.*

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AND

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Health.

As the title of this paper indicates, its scope is restricted to a consideration of the therapeutic value of the antitoxin treatment of tetanus. However, it is essential in order to obtain a just estimate of the value of the antitoxic serum that we appreciate certain principles which laboratory investigation seems to have firmly established, and that we study carefully our clinical experiences.

The Tetanus Bacillus.—Tetanus is essentially a dirt disease. Its etiologic agent, the tetanus bacillus, commonly inhabits the surface dirt, and yet it belongs to the class of bacteria incapable of developing in the presence of atmospheric oxygen.

*Read before the American Surgical Association, June 1, 1906.

It has been definitely shown by Debrand¹ and others, however, that oxygen-consuming bacteria, by using up the available oxygen in their development, create the proper anaërobic conditions necessary for the growth of the tetanus bacillus. This symbiotic growth of aërobic and anaërobic bacteria is an exceedingly common phenomenon in nature.

The tetanus bacillus and its spores have a most tenacious vitality and can live under natural conditions entirely unfavorable for the existence of most pathogenic bacteria. Living spores can exist in dust and other dry dirt.

The bacillus thrives best at the body temperature, and can develop but little, if at all, below 60° F. On this account it may be assumed that the organism is more active during the summer months. One of us has shown² that the large majority of cases of tetanus in New York State occur from May to October, with June, July and August as the months of maximum activity.

That it is a frequent habitant of the intestinal tract of animals, especially horses and cattle, has been amply shown by numerous workers, but more recently by Hoffman.³ This fact is important, as all wounds received in stables or contaminated with animal discharges are particularly to be feared. Pizzini⁴ has also found it in the fæces of man. Tavel⁵ and Libman⁶ describe an anaërobic spore-forming tetanus-like bacillus in the human appendix.

In this connection reference should be made to the clinical evidence of the source of infection in man being sometimes in the intestinal tract.

In Table I accompanying this paper are five cases following operations performed under aseptic conditions upon

¹Debrand. *Annales de l'Institut Pasteur*, 1902, 16, 427.

²Pease. *Medical Review of Reviews*, 1904, x, 524.

³Hoffman. *Hygienische Rundschau*, 1905, xv, 1233.

⁴Pizzini. Quoted by Hoffman.

⁵Tavel. *Centralblatt für Bakteriologie*, Erst. Abt. xxiii, 1898, 538.

⁶Libman. Quoted by Buerger. *American Journal Medical Sciences*, 1905, Series, cxxx, 267.

the intestines and reported by Brewer (Table I *a*₃₀), Goodrich (Table I *a*₄₄), Willy Meyer (Table L *b*₁₉), Kammerer (Table I *b*₂₀) and Roe (Table I *b*₄₅). Four of them were for the removal of the appendix in the quiescent period, and followed the operation twice nine and once ten and eleven days respectively, while in the fifth colectomy was performed for the removal of a cancer of the splenic flexure.

Rather more difficult of explanation is the portal of entrance of the bacillus in a case reported by Warbasse (Table I *a*₃₆), in which tetanus appeared six days after the performance of supravaginal hysterectomy and double oöphorectomy through an abdominal incision.

That tetanus can readily follow unclean surgical procedure appears in a case reported by Mudd (Table I *c*₁₂) in which it was the sequel of an open operation for varicocele performed by a doctor connected with an advertising institution and admitted into St. Luke's Hospital, St. Louis, after the disease had become established.

In a series of three cases reported by Fournéau as having occurred at the Goettingen klinik⁷ one followed a Bassini operation for the radical cure of hernia. This infection was attributed to a case of tetanus cared for on the preceding day. No case of tetanus having occurred in this klinik for seven years, the reporter states that they were thrown off their guard and proper precautions to avoid infection had not been taken.

The danger of the transmission of the disease in hospitals is not generally appreciated. In this country, as far as we are informed, the only hospital in which complete isolation from all other surgical patients is practised is the Pennsylvania, in Philadelphia, where all tetanus cases are transferred to the medical service for treatment.

Conditions of Infection.—The occurrence of idiopathic tetanus is most unlikely. It is essential for the production of the disease that the bacillus either in its vegetative or spore state, or its toxin, must gain entrance into the tissues

⁷Fournéau. Deutsche Medizinische Wochenschrift, 1904, 10.

of the body through some injury to the skin or mucous membrane. The disease is a true intoxication, and the tetanus toxin alone is capable of producing it. Yet tetanus toxin fed to animals is not absorbed as such through the uninjured digestive tract, but is either digested or passed out with the fæces unchanged.

Once having gained entrance into the tissues, the bacillus is capable of producing its toxin only under certain conditions.

Some years ago Vaillard⁸ and more recently Tarozi⁹ showed that the spores of the tetanus bacillus when freed from the toxin before injection into the body did not produce the disease, unless other substances were also injected, or conditions created which would bring about necrosis in the tissues.

While necrosis is essential for infection, neither the incubation, the onset, nor the severity of the attack is strictly dependent upon the amount of visible destruction of tissue or suppuration which takes place. The explanation of this is that minute quantities of tetanus toxin have the most powerful poisonous effect, and but very slight development of the bacillus is required for the production of several fatal doses of the poison. Thus Vincent¹⁰ has recently shown that the subcutaneous injection of small amounts of solutions of quinine and its salts, which contained tetanus spores deprived of their toxin, brought on fatal attacks of tetanus. In these cases the determining factor appeared to be the slight necrosis induced by the quinine injected. He states that tetanus is a frequent sequel to subcutaneous quinine injection, but a rare development after the subcutaneous administration of morphine. The latter drug, he states, does not produce necrosis.

⁸ Vaillard. *Annales de l'Institut Pasteur*, 1892, 6.

⁹ Tarozi. *Centralblatt für Bakteriologie Erst. Abt.* 1906, XL, Originole 305.

¹⁰ Vincent. *Annales de l'Institut Pasteur*, 1904, xviii, 748.

Another active factor in the determination of tetanus infection is the presence of aërobic bacteria in the injured area, and the symbiotic development of them and the tetanus bacilli. Thus von Hibler¹¹ has shown that mildly virulent tetanus bacilli can be enhanced in pathogenic power by coincident mixed infections; Garnier¹² that the injection of typhoid cultures together with tetanus toxin increased the toxic power of the latter, and Zanfroguini¹³ that the presence of the colon bacillus and the staphylococcus aureus had the same effect.

Distribution of the Tetanus Bacillus in the Body.—Ordinarily the tetanus bacillus is present in the body only at the site of injury. It has been shown, according to authors quoted by Tarozzi,⁹ in a few cases of tetanus in man that the bacillus was found at autopsy in the sciatic nerve, the spinal cord, the medulla oblongata, lymph nodes, cerebrospinal fluid, and spleen, and during life in the circulating blood. Tarozzi by experiment showed that spores injected into animals were found in a live state in the internal organs, especially in the liver, as late as three months afterwards.

Vincent¹⁴ found that if animals which had been injected with solutions containing spores freed from toxin were kept in incubators at high temperatures, that the bacteria were most likely to wander into the circulating blood and would develop and tetanic symptoms would be produced.

Of the sources of infection not yet mentioned is the injection of solutions containing gelatin for the purpose of controlling hæmorrhage. Two such cases are reported¹⁵ as having occurred at the klinik of Helferich in Kiel. In the first instance it was given subcutaneously into the thigh two hours before the performance of laryngectomy to prevent

¹¹ V. Hibler. Centralblatt für Bakteriologie, Erst. Abt. Ref. xxxvii, 545.

¹² Garnier and Sabareau. Archiv. de Med. Experiment, 1904, 16, 557.

¹³ Zanfroguini. Centralblatt für Bakteriologie, Erst. Abt. Ref., 1906, xxxvii, 650.

⁹ Tarozzi. *Loc. cit.*

¹⁴ Vincent. Annales de l'Institut Pasteur, 1904, xviii, 450.

¹⁵ Deutsche Zeitschrift f. Chirurgie, October, 1901.

uncontrollable capillary hæmorrhage. This it accomplished. But tetanus appeared six days after, with evident septic disturbance in the thigh. The muscles of the back and lower extremities were particularly convulsed. Death followed promptly, despite the use of the antitetanic serum. The field of operation in the neck showed no evidence of infection.

In the second case it was used to control secondary hæmorrhage occurring from a subphrenic abscess. After a period of six days severe tetanus appeared, which was fatal in two days.

Period of Incubation.—All the factors mentioned, as determining the occurrence of tetanus, exercise a proportionate influence upon the period of incubation, the character of the onset, the course, and the termination of the disease.

The period of incubation may vary within wide limits. Rose and many others have reported incubation periods as short as twenty-four hours and even less. If what is now quite generally accepted as the path of the poison from the site of its production to the nerve centers is correct, then such cases as have been recorded with periods of incubation under three days must be accepted with considerable reserve.

And yet a case reported by Kuhn of Cassel at the *Versammlung Deutscher Naturforscher und Aerzte*,¹⁶ offers a new explanation of this group of cases. A boy, a bleeder, had been operated upon for the removal of adenoids from his nasopharynx. The hæmorrhage being uncontrollable, a gelatin injection was given him. At the site of injection gangrene promptly appeared and after twelve hours general tetanus was present, from which death speedily resulted. Schuckmann¹⁷ commenting on this case expresses the opinion that the gelatin injection must have contained a poisonous dose of toxin, the injection of which, rather than the bacillus, caused the death.

¹⁶ *Berliner Klinische Wochens.*, 1901, p. 1118.

¹⁷ *V. Schuckmann. Deutsche Med. Wochens.*, 1903, March 5.

While a short incubation period usually implies intensity of infection, Warbasse (Table I *a*₃₈) reports the case of a patient 13 years of age, resulting from a punctured wound of the foot, from the penetration of a nail, with an incubation period of but four days. The treatment consisted in the injection of 20 c.c. of antitoxin subcutaneously. The case was one of general tetanus, yet terminated in recovery.

On the other hand in Table I appear seven cases in which the disease did not manifest itself until the nineteenth day in one, the twenty-first day in three, the twenty-fifth day in two and the twenty-sixth day in one. Four of these were treated with subcutaneous injection of the serum, two by intraspinal and one by deep intramuscular injection. All of the cases recovered except the last one. This patient, twenty-five days before, had received a punctured wound of the sole of his foot and entered Johns Hopkins Hospital on the first day of the disease. For a few days he seemed to improve under the serum treatment, and it was discontinued. Death occurred suddenly on the seventh day. This case must be considered as one in which the appearance of tetanus was delayed, but yet in which the infection was virulent when awakened into activity.

In Table II occur three cases with incubation periods of eighteen, nineteen, and twenty-two days respectively. One of them was so mild that recovery would have occurred under any treatment, and in another, the result of a burn, the general condition is stated to have been exceedingly bad and is held responsible for the death. The third recovered, having received 800 c.c. of antitoxic serum in the course of eight days.

It is interesting to note that in only one of these ten cases was a punctured wound responsible for the tetanus, most of them having been due to crushed or lacerated wounds.

The analysis of our tables furnishes some very suggestive facts upon this point. In them will be found 52 cases due to blank cartridge or gunshot wounds, presenting an

average incubation period of 7.3 days with a mortality of 76 per cent., and 51 punctured wounds with an average incubation period of 7.9 days, a mortality of 74.5 per cent., while in the 28 lacerated wounds tabulated, the incubation period was 11.8 days and the mortality 53.6 per cent.

We must now consider what occurs during the period which intervenes between the receipt of the injury and the appearance of the first tetanic manifestations.

The relation of toxin to the nervous system.—New light has been shed upon the pathology of tetanus by the researches of Meyer and Ransom¹⁸ and Marie and Morax.¹⁹ Their work has been reviewed so frequently that it is only necessary at this time to recall the main conclusions that have been reached.

The presence of tetanus toxin in the living body causes no symptoms, clinically appreciable, until it has been absorbed by the muscular terminations of the motor nerves, has passed along their axis-cylinders, and has reached the motor root-cells in the spinal cord. While the toxin is in the nerves, or in the spinal cord acting upon the spinal cells, it is effectually isolated from antitoxic substances present in the blood or lymph circulations. If, however, a nerve, or the spinal cord, be injured in such a manner as to expose the axis-cylinders or the nerve-cells to the toxin in the blood or lymph, the affinity of the toxin for such nerve element is soon manifested by awakening a tetanic condition in the part controlled by that nerve or the affected nerve-cells. Odier²⁰ claims that the toxin has a lytic effect on the out-runners of the motor end-plates, and that it has a somewhat similar effect upon the axis-cylinders of the nerves, pro-

¹⁸Meyer and Ransom. *Archiv. fur Experimentelle Pathologie und Pharmakologie*, 1903, 49, Heft 6.

¹⁹Marie and Morax. *Annales de l'Institut Pasteur*, 1902, xvi, No. 11, and 1903, xvii, No. 5.

²⁰Odier. *Archives de Médecine Experimentale et d'Anatomie Pathologique*, 1904, 16, 451.

portional to the amount and concentration of the toxin passing through them. In other words, it is apparently possible for the toxin to come in contact with the nerve elements for which it has a strong affinity at only one point, namely, at the termination of the motor-nerves in the muscles. The time taken for the toxin to be absorbed and to pass through the nerves represents the large part of the period of incubation. Courmont and Doyan²¹ have shown that the period of incubation in different animals is roughly proportionate to the distance between the termination of a nerve and its central nerve-cell. The early appearance of trismus, in natural infections, can be explained by the fact that the nerve supplying the muscles of mastication is a comparatively short one. Thus, the period of incubation is the net result of the length of nerve and the degree of concentration of toxin at the point of its absorption by the nerve terminals.

It is apparently established that the toxin produced at the portal of entry of the tetanus bacillus is absorbed by the muscular terminations of the motor-nerves of the part as well as the lymphatics, is transported directly through the axis-cylinders of the nerves to the cord, and also by an indirect route through the lymphatics to the blood and thence by way of other nerve fibres to the spinal cord.

Tetanus antitoxin.—There is not the slightest question of the power of tetanus antitoxin to neutralize free tetanus toxin outside the body or in the circulating blood or lymph channels. To what extent it can release the organ-bound toxin has not yet been determined. There is no experimental nor clinical evidence that it has any effect on the toxin passing along the axis-cylinders of the nerves, even if it is present in large amounts in the circulating blood.

The histologic arrangement of the parts prevents the toxin present in the blood and lymph from acting directly upon the sensitive nerve-cells, despite its apparent pro-

²¹Courmont and Doyan. Quoted by Marie and Morax.

pinquity. This same condition affords an effective barrier, which likewise prevents the neutralization of the toxin by the antitoxin when once the latter has passed into the axis-cylinders and has reached the nerve-cells.

The absence of a standard method of expressing the antitoxic strength of tetanus antitoxin renders it impossible to properly estimate the exact amount administered in a given case and materially interferes with our reaching definite conclusions in this regard in studying the accompanying tables.

A committee has been appointed by the Society of American Bacteriologists, to whom this matter has been referred, and we shall have, therefore, before long a standard serum of known strength.

While in the cases reported in this paper an effort has been made to specify the names of the producers of the antitoxin used, no comparison of the relative merits of the different varieties has been attempted.

A review of our tables will indicate that in many instances what might be considered large doses have been freely administered, and aside from the occasional occurrence of urticaria or dermatitis no ill effects have been noted.

Preventive Injections.—From what has been said, it is quite evident that antitoxin to be of the greatest service must be administered before the motor-nerves have absorbed any toxin. The serum should, therefore, be administered as soon after the infliction of the injury as possible, and should be given to every person who has sustained an injury in which dirt, manure or foreign substance could possibly have been carried into the wound. Injuries received by persons whose labor brings them in contact with the soil, or whose work is among domestic animals, should be regarded as suspicious and should receive the tetanus antitoxin as a part of the routine treatment.

These preventive injections should, however, be given intelligently, and the size of the injection, the site chosen,

and its repetition, should be regulated by the character and location of the injury.

Injuries involving the nerve-trunks should be treated with antitoxin locally as well as subcutaneously, in order to avoid the direct absorption of toxin by such injured nerves. For this purpose either liquid or dried antitoxin is suitable.

In injuries considerably contaminated by dirt the prophylactic dose given at the first dressing should be repeated on the third and fifth days, and again from the fifteenth to the twentieth day if suppuration still continues. The passive immunity conferred by a single prophylactic injection of tetanus antitoxin undoubtedly is of no longer duration than is that given by a similar injection of diphtheria antitoxin. This on the average is from three to four weeks. Yet the protection may be but for a few days. The virulence of the toxin may be maintained, although the outbreak of tetanus is deferred. As evidence of this, Sejour²² reports a fatal case of only twenty-four hours' duration, the onset of which occurred twenty-two days after the injection of a prophylactic dose in a case of compound fracture.

Suter²³ reports a case of tetanus occurring forty-seven days after the use of one prophylactic dose. He has collected eleven other cases from literature.

We are able to add six cases to this list from reports made to us personally. They are, briefly, as follows:

CASE I.—Age 8; reported by Dr. A. J. Ochsner; treated at St. Mary's Hospital, Chicago. Compound comminuted fracture of the left leg. One injection of 10 c.c. antitoxin of French make given sixteen hours after injury. No unfavorable symptoms until the twelfth day, when trismus and opisthotonos appeared, but which subsided after forty-eight hours; the patient then making an uneventful recovery.

²²Sejour. *Gazette des Hopitaux*, 1905, lxxviii, 606.

²³Suter. *Archiv fur klinische Chirurgie*, 1904, lxxx, 113.

Reference *Centralblatt fur Bakteriologie Erst. Abt. Referate*, 1906, xxxvii, 675.

CASE II.—Reported by Dr. Leonard Freeman, of Denver, Colo., the injury being a punctured wound of the foot due to a nail; 10 c.c. were given several hours after the injury. Local irritation and a pronounced general erythema lasting several days occurred. Six days later there was mild trismus, with soreness of the shoulders and legs. Recovery.

CASE III.—Occurred at the Pennsylvania Hospital, Philadelphia, in the service of Dr. James Tyson. The patient, forty-eight years of age, received a punctured wound in the palm of the right hand caused by a rusty nail. Four days later 30 c.c. of antitoxin were injected about the wound. On the eighth day there was pain and stiffness of the corresponding arm and forearm, associated with painful mastication. This disappeared in the course of three days.

CASE IV.—Dr. J. H. Branan, Albany, N. Y., cared for a boy fourteen years old, who received on July 4, 1905, a lacerated wound of the hand from the premature explosion of a cannon. Tetanus bacilli were found in a smear taken from the middle finger. He received an intramuscular injection of 10 c.c., July 7, and a like injection July 15. Between these latter dates he suffered from stiffness of the jaws and of the neck muscles, which cleared up and the patient recovered.

CASE V.—Dr. L. L. McArthur, of Chicago, contributes the fifth to this list of cases. The patient was injured in a street-car accident, having been rolled, crushed, and then dragged a distance before being rescued. A compound comminuted fracture of the skull resulted, dirt being ground into the wound. Both upper and lower extremities had open comminuted fractures. The injured parts received thorough surgical attention, and were made clean. On the first, second and third days she received 30 c.c. of Behring antitoxin. On the eleventh day, the wounds having done well, the scalp wound was drawn together by suture. Two days later there was a rise of temperature to 102° , and on the following day, the fourteenth after the receipt of the injury, there was trismus so that the jaws could be separated only three-eighth of an inch, and stiffness of the neck; 20 c.c. of antitoxic serum were administered. The next day an injection of 30 c.c. was given. From this time on there was a disappearance of the tetanic manifestations.

CASE VI.—Dr. James Bell (Table I b47) reports the case of a patient, aged 9, treated in the Royal Victoria Hospital, Montreal. He had sustained a contused and lacerated wound of the skin over the tibia and was given 5 c.c. of antitetanic serum as a prophylactic injection on the day following the injury. Although tetanus did not appear until the forty-seventh day thereafter, it was so virulent as to cause death in five days.

It is to be noted, however, in all of these cases with the exception of the sixth, that the toxin was so modified in its intensity that the tetanic symptoms were of short duration and in each instance the patient recovered. In the

latter, however, although the outbreak was delayed, the virulence of the toxin persisted.

Letters received from members of this association indicate that it is the practice in the hospitals of New York, Chicago, Baltimore, Cincinnati, Cleveland, Boston, Montreal, Brooklyn and Albany to use the antitoxin prophylactically and to inject it usually subcutaneously, although in Cleveland it is given into the spinal canal, in all of the cases in which it is believed that there is danger of the development of tetanus, and with the exceptions mentioned the disease has never appeared after such injection.

At the fifteenth congress of French surgeons the treatment of tetanus was most exhaustively considered.²⁴ The subject was presented by M. Vallas, of Lyons. Speaking of the preventive power of the injections of the antitoxic serum, he is most emphatic in his decision that it is an agent of such positive value that with its constant use tetanus would cease to exist altogether.

No one will pretend to claim that the prophylactic injections are to take the place of the efforts to be made in each instance to render the parts thoroughly clean at the primary dressing, or to remove all possible infected tissues.

In many hospitals reliance is placed upon these procedures, and indeed this has been the policy in the hospital with which one of us is connected. In this hospital several hundred cases of wounds of such character as might have been followed by tetanus have been thus treated, and yet there has been no occurrence of that disease since 1899.

We have received the report of a number of cases treated at various of the large hospitals of the country, where excision of the infected area was practised when possible, and thorough cleansing and disinfection where this could not be done and where no serum has been used, yet tetanus has

²⁴Association Francaise de Chirurgie, 1903.

not occurred. This subject has also been considered by Bain²⁵ and Richardson.²⁶

In the cases reported by the latter, however, the use of the antitoxic serum was combined with thorough surgical attention.

This combination of procedures is the one which should be pursued. The prophylactic injections should be given directly into the muscles, as this method affords more rapid absorption than when carried only into subcutaneous tissues as has been shown by Meltzer and Auer.²⁷ The injection of antitoxin into adipose tissue, as is frequently done, is probably a waste of effort and material.

The necessity of giving these injections early, so that they may indeed be protective, is made exceedingly clear when we realize that if the necessary time elapses after the introduction of the bacilli for the development of a sufficient amount of toxin, not even amputation will prevent the appearance of tetanus.

Two cases in Table I illustrate this point. In the first (Table I b23) a man sustained a compound fracture of the leg April 24, 1902, because of which the leg was amputated at the New York Hospital April 30th. Despite this, tetanus appeared May 3, and death occurred the next day.

In the second (Table I a52) a man run over by an electric car December 26, 1905, was brought three and one-half hours later into the Massachusetts General Hospital. The wound became septic, and amputation was performed December 30th. The next day the temperature rose to 105, the neck became rigid and dysphagia appeared. Despite antitoxin, then given subcutaneously, he died January 3, 1906.

Local Tetanus.—Before considering the therapeutic use of tetanus antitoxin, there remain some points to be emphasized which have a bearing thereon.

²⁵ Bain. ANNALS OF SURGERY, 1903, Vol. 37, 399.

²⁶ Boston Medical and Surgical Journal, 1905, Vol. 152, 493.

²⁷ Meltzer and Auer. Journal of Experimental Medicine, 1905, 7, 59.

Tetanus provoked in animals as a result of experimentation exhibits almost without exception as its earliest manifestations those of a purely local character and which are at first restricted to the neighborhood of the inoculation. This is now understood to be due to the absorption of the toxin by the motor-nerve of the part. The conditions favoring the local appearance of tetanus are a short motor-nerve as in head injuries; an injury to a nerve-trunk permitting the rapid absorption of a large amount of toxin; the production of a meager amount of toxin or the presence of something which prevents the admission of a large amount of toxin into the circulation.

Axhausen²³ reports eleven cases in man with but a single death in which distinct local tetanic symptoms preceded the usual manifestations. After studying these cases he concluded that they had a long incubation period averaging twenty days, that the symptoms were slow to develop and likewise to decline. In Table I will be found ten cases in which local manifestations in the part injured preceded the other evidences of tetanus.²⁹ Three of them resulted from head or face injuries, all recovering; two were blank cartridge wounds of the hand, one recovering; one a lacerated hand; two gunshot wounds of the thigh; one due to an abrasion of the shin; and one to a penetrating wound of the foot. The two latter recovered. The average incubation period of this group was only 9.2 days, however. Six of them recovered, showing a mortality of only forty per cent. Our cases, therefore, verify in the main the statements of Axhausen, although the mortality was considerably higher.

Classification of Cases.—Recognizing the fact as previously stated that the length of the incubation period is as a rule a good index of the virulence of the infection, for the purpose of estimating the value of the serum treatment we

²³ Axhausen. *Deutsche Zeitschrift für Chirurgie*, 1905, 78, 265.

²⁹ Table I a, Cases 16, 17, 24, 28, 42, 45. Table I b, 7, 21. Table I c, 8. Table I d, 2.

have divided the cases herewith submitted into two classes and shall speak of those as acute in which the incubation period was of less than ten days' duration, and of those as subacute when it was ten days or longer.

Believing that it is but natural that men would as a rule be more apt to publish their successes than their failures, we have not attempted to collect from literature the cases of tetanus which have been subjected to serum treatment. Two tables, however, are presented. The first represents the experiences gathered from many of the large hospitals of the United States. It is believed that as the table includes all of the cases treated at these institutions, and in a few instances in the private practice of their surgeons, a truer estimate of the real worth of the antitoxic serum could thus be obtained. The second covers all of the cases treated in New York State in which the State Department of Health furnished antitoxin. The data for this group of cases are furnished by Dr. Pease, one of the writers of this paper, who is the director of the antitoxin laboratory of this state.

In Table I there are 144 cases, in No. II 59, placing at our command 203 cases. Of those in Table I, 66 were treated by subcutaneous injection; 48 by injection of the serum into various structures; 12 by intraspinal; 16 by intramuscular; one by intracerebral, and one by intravenous injection.

Of the 59 cases in Table II, 42 were treated subcutaneously; 16 by injection into different tissues, and 1 by intracerebral injection.

In Table I there were 93 acute cases, the termination being known in 91. Of these 78 died, a mortality of 85.7 per cent. The number of subacute cases in this table is 44. The final result is given in 43. There were 15 deaths, a mortality of 34.9 per cent. In six the incubation period is not mentioned.

In Table II the termination was given in 36 acute cases; 29 died, mortality 80.6 per cent. Of 21 subacute cases in

which the result is given there were 11 deaths, a mortality of 52.4 per cent.

The mortality attending the various methods of administering the antitoxin shows the following in Table I:

Of 66 cases treated by subcutaneous injections, the incubation period is not mentioned in one case. Of the remaining 65, 47 were acute cases, the termination being known in 46. Of these 38 died, mortality 82.6 per cent. 18 were subacute, of which but four died, mortality 22.2 per cent.

In 48 cases treated by a combination of either subcutaneous, intraneural, intraspinal, intravenous or intracranial injections, the result is mentioned in 47. Of these 30 were acute, the termination being known in 29; 27 dying, a mortality of 93.1 per cent; 14 were subacute cases, of whom 7 died, mortality 50 per cent.

By intraspinal injection 12 were treated, in one the incubation period not being stated; seven were acute cases, 4 dying, mortality 57.1 per cent. In three subacute cases, in which the result was known, all recovered. Of 16 cases treated by intramuscular injection, in one the incubation period is not given. Of the remaining 15, 7 were acute, all dying; mortality 100 per cent. Of the remaining 8 subacute cases, 4 died; mortality 50 per cent.

In Table II a study of the cases results as follows: By subcutaneous injection 42 were treated; the incubation period was known in 40, and of this number 24 were acute, of whom 19 died; mortality 79.2 per cent. Of the 16 subacute cases thus treated, 7 died; mortality 43.8 per cent.

Sixteen were treated by the injection of the antitoxin into the several structures mentioned in a previous paragraph. Eleven were acute cases, 9 dying; mortality 81.8 per cent.; while of 5 subacute cases four died, a mortality of 80 per cent.

In each table there is recorded a single case treated by intracerebral injection alone. Both patients died.

In Table I there appears one acute case treated by intravenous injection. This patient died.

The tables were carefully analyzed for the purpose of studying the degree of virulence of the cases treated by the different methods, and it appears that a larger percentage of cases with a short period of incubation, rapid progress and an early death, were treated by subcutaneous injection than by any other method.

As to the amount of antitoxin injected, in but 20 cases were more than 500 c.c. administered. These cases had an average incubation period of 10.8 days ; 15 recovered and 5 died, a mortality of 25 per cent. Five of the 15 recovering had short periods of incubation. The treatment was begun in these cases on an average 3.3 days after the appearance of tetanic symptoms, and the average length of its continuance was 7.4 days. The largest amount of antitoxin given a single patient was 1495 c.c. Of the 20 cases, seven are found in Table I, with two deaths, mortality 28.6 per cent. ; and 13, with three deaths, mortality 23 per cent., in Table II.

It is apparent that the amount of antitoxin administered to these patients is not the only factor to be considered in their recovery, for as a group they belong to the subacute class.

It should be stated that in most of the cases included in our tables medicinal treatment was given in addition to the serum. Occasionally it will be noted that the reporter has commented to the effect that he attributes in a given case quite as much to the drugs as the serum.

Reference might here be made to the paper by Anders and Morgan.³⁰ It is based upon 252 cases, in 115 of which the antitoxic serum was used. But the details of its use are so meagerly stated that we are not able to estimate its worth in the cases quoted. A few of these cases appear in our Table I. However, their conclusions as to the value of

³⁰Anders and Morgan. *Journal of the American Med. Assn.*, July 29, 1905.

serum therapy do not differ materially from those we are compelled to reach.

Treatment of Tetanus.—From the facts here presented, it is apparent that after tetanus is fully established serum therapy, however administered, promises but little as a curative agent.

A word as to the special methods of injection. The intracerebral method first practised with apparent success by Roux and Borrel³¹ experimentally in animals, was received for a short time with favor by the profession. The results obtained by it were not particularly encouraging. The two cases reported in our tables as having been treated by intracerebral injection alone, both died. Table I *b* contains a list of 11 cases treated by a combination of subcutaneous and intracranial injections. Four of these cases received also intravenous injections. Of the 11 thus treated, but one recovered, a mortality of 91 per cent.

The method has nothing particularly to commend itself as a means of reaching either the free toxin or that fixed to cells of the nervous system. Moreover, it is not devoid of danger, as in the case reported by Gibb³² first as cured and later³³ as having died of cerebral abscess. At the autopsy each frontal lobe contained an abscess cavity, the left one communicating with the left lateral ventricle, and through the great transverse fissure with the cerebellar fossæ. Every effort was made, we are assured, to perform the operation aseptically. The serum was believed to have been sterile. The suppurating condition was attributed to the frequent repetition of the injection.

The injection of tetanus antitoxin into the subdural space by means of lumbar puncture was devised by Blumenthal and Jacob.³⁴ This method has been used extensively.

³¹Roux and Borrel. *Annales d'Institut*, 1898, 12, 225.

³²Wm. F. Gibb. *British Med. Journal*, April 15, 1899.

³³Wm. F. Gibb. *British Med. Journal*, July 1, 1899.

³⁴Blumenthal and Jacob, *Berliner klinische Wochenschrift*, 1898, 32, 1079.

Without carefully analyzing the cases in our table I c, we might be led to estimate the value of this method above its real worth. It should be noted, however, that two of the cases had an incubation period of twenty-one and twenty-six days respectively, both recovering, and that in the four cases reported by Luckett, all of whom recovered, the reporter lays greater stress upon the withdrawal of the cerebrospinal fluid than upon the injection of the antitoxin. This was done because the claim is made that it is rich in toxin and that by its withdrawal a large amount of toxin is removed. That this assumption is unwarranted appears from the investigations of Jacob and Blumenthal,³⁵ Meyer and Ransom,¹⁸ Millian and Legros.³⁶ Luckett withdrew 161 m., 605 m., 1556 m., and 3610 m., of spinal fluid in these cases respectively. Moreover, it will be noted that in two of his cases local tetanus preceded the general manifestations, a condition which we have shown indicates a mild attack of tetanus; while a third case (No. 9 of this table) it appears to us cannot be absolutely regarded as one of tetanus, and his fourth case is to be classed as subacute, judged by the incubation period.

The injection of antitoxin into the subdural space offers but little prospect of reaching the affected nerve-cells because of the protection offered by the pia mater. It has been demonstrated that even the tetanus toxin injected into the subarachnoid space does not reach the nerve-cells directly.

For this reason it has been suggested that the antitoxin be carried more deeply, and that it be introduced either into the cord or the cauda equina. Rogers³⁷ has practised this method in connection with intraneural and intravenous injections in six cases, with three recoveries. A seventh case included in his report occurred in a patient who punc-

³⁵ Jacob and Blumenthal. Berlin, Kl. Wochensch., 1898, 49. -

¹⁸ Meyer and Ransom. *Loc. cit.*

³⁶ Milian and Legros. Soc. de Biol., March, 1901.

³⁷ Rogers. Journal of Amer. Med., Apl., July 1, 1905.

tured his left wrist with a hook July 2, 1904, and the palm of his right hand with the same hook July 10, 1904. He was not admitted into the hospital until August 10, 1904, so that there was an incubation period of not less than thirty-one and it might have been as long as thirty-nine days. This patient received a single injection into the nerve-trunks of each upper extremity of five and ten minims respectively and 10 c.c. subcutaneously in the neighborhood of the wound in each extremity. It seems to us that this case should be considered apart from the others. Of the other three recoveries one had an incubation period of sixteen days and ran a mild course, while the other two were acute cases and the results obtained were most gratifying.

The three fatal cases were all due to crushing wounds of the extremities; two having incubation periods of ten and eleven days respectively, and one of six days.

Meyer and Ransom¹⁸ recommended that attempts be made to neutralize the toxin present in the large nerve-trunks by the injection of antitoxin into them, and reported one case in which an attack of local tetanus was relieved by the injection of antitoxin into the motor-nerves controlling the tetanized region.

Kuster³⁸ reported to the German Surgical Congress at its session in 1905, a similar case of localized tetanus which was relieved by injections of the proper nerves. In reviewing this case he expressed the opinion that intraneural injections could be of benefit only while tetanus is localized. Kocher and other German surgeons in the course of the discussion endorsed this view, agreeing that only the toxin present in the injected nerve could be thus neutralized. It is even doubtful whether it is possible to neutralize any considerable portion of the toxin in a given nerve by intraneural injections. Fletcher³⁹ has shown very definitely that it is

¹⁸Meyer and Ransom. *Loc. cit.*

³⁸Kuster. Abstract of proceedings of German Surgical Congress, 1905.

³⁹Fletcher. *Brain*, 1903, 26, 383.

not an easy matter to inject a nerve-trunk so that any large number of its axis-cylinders become exposed to the fluid injected. In several of his experiments in which toxin was injected into nerves the poison passed directly into the lymph-spaces of the endoneurium and did not reach any of the axis-cylinders, for no tetanus resulted. Only when he injured a considerable number of the axis-cylinders of the nerve by his injection did he succeed in producing absorption of the toxin by the axones.

Theoretically, if antitoxin comes in contact with a marked number of the axis-cylinders of an injected nerve-trunk, the symptoms in the region controlled by that nerve should cease very shortly and not recur. This is what took place in Kuester's case, for there occurred a subsequent painful myositis of the muscles supplied by the injected nerves. Intraneural injections no doubt interrupt the current through the axis-cylinders because of the mechanical pressure they produce, and thus prevent the absorption of the toxin for the time being.

But a word is necessary, in conclusion, to summarize the results of serum therapy in the light of the laboratory studies referred to and the clinical experiences herewith submitted. As a prophylactic measure it merits our fullest confidence, but as a therapeutic agent after tetanus is fully established we are forced to admit that as yet no method has been discovered whereby it can be administered so as to reach effectively the toxin not free in the blood or lymph.

CASES OF TETANUS TREATED IN HOSPITALS OR BY HOSPITAL SURGEONS WITH ANTITOXIC SERUM ADMINISTERED BY SUBCUTANEOUS INJECTION.

CASE 1.—KEEFE, Rhode Island Hospital. Age 23. Punctured wound of foot by rusty nail. Tetanus bacilli found. Period of incubation, 5 days; trismus—rigidity of cervical muscles; general convulsions 3 days later; treatment began second day; continued 2 days. Subcutaneous injection of antitoxic serum, first day: 2 injections, 30 c.c. each, = 60 c.c.; second day: 5 injections, 60 c.c. each, = 300 c.c. Total amount injected, 360 c.c. Death on third day after admission.

CASE 2.—HERSEY, Rhode Island Hospital. Age 51. Small punctured wound of scalp; rusty nail. Tetanus bacilli found. Period of incubation, 7 days; trismus; general convulsions next morning; treatment began first day; continued 1 day. Subcutaneous injection of antitoxic serum, one injection,

40 c.c. Total amount injected, 40 c.c. Sudden convulsion next morning and death.

CASE 3.—MUNRO, Rhode Island Hospital. Age 10. Blank cartridge wound of hand; 4th of July accident. Period of incubation, 8 days; trismus; stiffness cervical and spinal muscles; treatment began third day; continued 1 day. Subcutaneous injection of antitoxic serum, in several injections, 300 c.c. Total amount injected, 300 c.c. Course and termination unknown.

CASE 4.—HERSEY, Rhode Island Hospital. Age 44. Two fingers crushed by falling log. Period of incubation, 21 days; moderate trismus and rigidity of neck, slight opisthotonos; general convulsions frequent but slight; treatment began first day; continued 4 days. Subcutaneous injection of antitoxic serum, 8 injections daily, 40 c.c. Total amount injected, 1280 c.c. Dismissed cured after 20 days.

CASE 5.—GODDING, Rhode Island Hospital. Age 59. Burn of both feet, second degree. Tetanus bacilli found. Period of incubation, 9 days; delirium, trismus; treatment began second day; continued 1 day. Subcutaneous injection of antitoxic serum, 2 injections, 20 c.c. each. Total amount injected, 40 c.c. Death one-half hour after second injection.

CASE 6.—MUNRO, Rhode Island Hospital. Age 55. Right thumb crushed working in lumber yard. Period of incubation, 5 days; trismus; general convulsions 2 days later; treatment began on second day; continued 1 day. Subcutaneous injection of antitoxic serum, 1 injection, 20 c.c. Total amount injected, 20 c.c. Death three and a half hours later.

CASE 7.—MITCHELL, Rhode Island Hospital. Age 50. Wound of bridge of nose; fall on stairs. Period of incubation, 12 days; 7 days after injury slight twitching of jaw muscles—disappeared; trismus twelfth day; treatment began third day; continued 10 days. Subcutaneous injection of antitoxic serum, first day, 1 injection, 40 c.c.; second to ninth days, every 6 hours, 20 c.c. Total amount injected, 760 c.c. Left hospital on 25th day; weak and with slight trismus persisting.

CASE 8.—ROSWELL PARK; private patient. Age 21. Toy pistol; second finger left hand. No tetanus bacilli found. Period of incubation, 10 to 11 days; trismus; soreness muscles back of neck; dysphagia; treatment began second day; continued about 15 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, first day, 3 injections, 10 c.c. = 30 c.c.; afterwards 1 to 2 injections, 10 c.c. each until 27 had been given. Total amount injected, 270 c.c. Recovered.

CASE 9.—M. W. RAYNOR, Newark City Hospital, Newark, N. J. Age 11. Punctured wound of foot; rusty nail. Tetanus bacilli found. Period of incubation, 8 days; trismus, extreme opisthotonos, T. = 101°–102.5°, dysphagia, general pain, retained urine, delirium; general convulsions; treatment began on first day; continued 12 days. P. D. & Co.'s and Mulford's antitoxin used. Subcutaneous injection of antitoxic serum, first day, one injection, 40 c.c.; second to seventh days, every 4 hours, 30 c.c.; next 2½ days, every 6 hours, 20 c.c.; last 2 days, every 8 hours, 10 c.c. Total amount injected, 1380 c.c. Recovered.

CASE 10.—GEO. TULLY VAUGHAN, Emergency Hospital, Washington, D. C. Age 27. Punctured wound left foot; rusty nail. Period of incubation, 7 days; trismus; stiffness of neck, cramps in abdomen, weak mucous râles; P. = 90–120; T. = 99°–102°; general convulsions; treatment began fourth day; continued 4 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 15 injections of 20 c.c. each in 4 days. Total amount injected, 300 c.c. Pneumonia on sixth day and death on eighth day.

CASE 11.—GEO. TULLY VAUGHAN, Emergency Hospital, Washington, D. C. Age 59. Compound comminuted fracture left leg; wound suppurated. Period of incubation, 11 days; trismus, dysphagia; treatment began on second day; continued 2 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 7 injections in 2 days, 20 c.c. each. Total amount injected, 140 c.c. Death in severe general convulsions on second day.

CASE 13.—GEO. TULLY VAUGHAN, Emergency Hospital, Washington, D. C. Age 33. Punctured wound sole of foot; nail. Period of incubation, 5 days; trismus, rigidity of abdomen and back; general convulsions; treatment began on second day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 8 injections; 25 c.c. every 3 hours. Total amount injected, 200 c.c. Death 24 to 36 hours after appearance of symptoms.

CASE 13.—GEO. TULLY VAUGHAN; private. Age 25. Calf right leg impaled on rusty hook. Period of incubation, 7 days; complete trismus, next day cramps in abdomen; treatment began on second day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 8 injections; 25 c.c. q. 3 hours. Total amount injected, 200 c.c. Death on third day.

CASE 14.—C. B. G. DE NANCREDE, University of Michigan Hospital. Age 16. While working in livery barn stepped on nail. Puncture wound of right foot. Period of incubation, 7 days; felt ill on seventh day; pronounced tetanic convulsions ninth day after injury; treatment began on fourth day; continued 3 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 18 injections; 10 c.c. q. 4 hours. Total amount injected, 180 c.c. Leg amputated; death on sixth day.

CASE 15.—C. B. G. DE NANCREDE, University of Michigan Hospital. Age 15. Contused wound from explosion of cannon cracker, 4th of July. Tetanus bacilli found. Period of incubation, 6 days; fifth day pain in region of oesophagus; sixth day, trismus; general convulsions; treatment began first day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 6 injections; 10 c.c. q. 4 hours. Total amount injected, 60 c.c. Arm amputated; death on third day.

CASE 16.—LEONARD FREEMAN, St. Joseph's Hospital, Denver, Col. Age 55. Superficial excoriation of skin. No tetanus bacilli found. Period of incubation, 21 days; cramps in leg; trismus; right arm cramped; T. = 99°–100°; treatment began on third day; continued 2 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 15 c.c., repeated in 6 hours, and twice thereafter at 8 hour intervals. Total amount injected, 60 c.c. Recovery; attributed to medicines given and not to serum.

CASE 17.—PATCH, Montreal General Hospital. Age 27. Lacerated wound, bridge of nose, abrasion of face. No tetanus bacilli found. Period of incubation, 6 days; fourth day—twitching, both sides of face, stiffness of eyelids; fifth day, worse; sixth day, trismus; no stiffness of neck muscles, superficial reflexes normal; (entered hospital this day); T. = 102°–104°; later stiffness of neck and back; some opisthotonos; treatment began on third day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, first injection, 20 c.c.; afterwards every 6 hours—27 injections. Total amount injected, 300 c.c. At first grew worse, then gradual improvement and ultimate recovery.

CASE 18.—JOHN C. MUNRO, Boston; private. Age 19. Lacerated finger; crushed by door. No tetanus bacilli found. Period of incubation, 9 days; ninth day, sore throat, headache and dysphagia; eleventh day, trismus, and later (same day) opisthotonos; treatment began on second day; continued 2 days. Subcutaneous injection of antitoxic serum given by attending physician; amount not known. Death.

CASE 19.—P. E. RUNTS, Cleveland; private. Age 10. Lacerated right eyebrow and lid. Fall from street car—dirt ground in. No tetanus bacilli found. Period of incubation, 9 days; ninth day, moderate degree of trismus; tenth day, swallowing water produced violent spasm and opisthotonos; general convulsions; treatment began on second day; continued 1 day. Subcutaneous injection of antitoxic serum, 10 c.c. q. 4 hours, 6 injections. Total amount injected, 60 c.c. Death on third day.

CASE 20.—DUDLEY P. ALLEN, Lakeside Hospital, Cleveland, Ohio. Age 18. Blank cartridge wound of hand. Tetanus bacilli found. Period of incubation, 7 days; painful spasms of face, neck, back, and extremities; hypersensitive; treatment began first day; continued 36 hours. P. D. & Co.'s antitoxin used.

Subcutaneous injection of antitoxic serum, 7 injections; 10 c.c. q. 4 hours. Total amount injected, 70 c.c. Death after 36 hours.

CASE 21.—DUDLEY P. ALLEN, Lakeside Hospital, Cleveland, Ohio. Age 12. Blank cartridge wound of hand. Part of wad still in hand on admission. No tetanus bacilli found. Period of incubation, 8 days; muscles of lower jaw, face, neck and abdomen rigid on admission; general convulsions; treatment began on second day; continued 6 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 20 injections, 10 c.c. q. 6 hours for 5 days. Total amount injected, 200 c.c. Death on seventh day.

CASE 22.—DUDLEY P. ALLEN, Lakeside Hospital, Cleveland, Ohio. Age 13. Blank cartridge, left hand. Opened, cauterized, packed, July 4th. No tetanus bacilli found. Period of incubation, 7 days; neck stiff; throat felt queer; not marked on admission; treatment began on first day; continued 5 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 18 injections; 10 c.c. q. 6 hours for 5 days. Total amount injected, 180 c.c. Death on fifth day.

CASE 23.—DUDLEY P. ALLEN, Lakeside Hospital, Cleveland, Ohio. Age 8. Blank cartridge wound of scrotum. Admitted on seventh day. No tetanus bacilli found. Period of incubation, 7 days; head retracted; trismus; general convulsions; treatment began on first day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, single injection, 5 c.c. Total amount, 5 c.c. Death following morning, 2 A.M.

CASE 24.—DUDLEY P. ALLEN, Lakeside Hospital, Cleveland, Ohio. Age 8. Blank cartridge wound palm of right hand. No tetanus bacilli found. Period of incubation, 7 days; slight contractions fingers injured hand; characteristic cry at intervals; next day head retracted; slight trismus; treatment began first day; continued 2 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 8 injections, 10 c.c. q. 6 hours. Total amount injected, 80 c.c. Death on third day.

CASE 25.—ED. H. OCHSNER, Augustana Hospital, Chicago. Age 12. Gunshot wound through hypothenar eminence left hand. No tetanus bacilli found. Period of incubation, 13 days; moderate degree trismus and opisthotonos; treatment began first day; continued 2 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c. at 6 and 11 P.M. Next day 8 A.M., 3 P.M., 11.30 P.M., and 10 A.M. following day. Total amount injected, 60 c.c. Gradual recovery.

CASE 26.—EMMET RIXFORD, Lane Hospital, San Francisco. Age 35. Punctured wound of foot. Patient farm hand. Nail passed through shoe. No tetanus bacilli found. Period of incubation, 12 days; facial contortion first, then mild trismus and spasm of trapezius, neck and abdomen; treatment began eleventh day; continued 3 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 7 injections q. 10 c.c. Total amount injected, 70 c.c. Chloral and bromides also used. Recovery in 27 days.

CASE 27.—EMMET RIXFORD, Lane Hospital, San Francisco. Age 14. Lacerated wound of leg opening knee; compound fracture fibula. Head of bone covered with manure. No tetanus bacilli found. Period of incubation, 7 days; violent spasms including respiratory tract—opisthotonos; general convulsions; treatment began second day; continued 3 days. P. D. & Co.'s and Pasteur Institute antitoxin used. Subcutaneous injection of antitoxic serum, second day, 10 c.c.; third day, 20 c.c.; fourth day, 10 c.c. Total amount injected, 40 c.c. Death on fourth day.

CASE 28.—EMMET RIXFORD, Lane Hospital, San Francisco. Age 50. Perforating wound of lower lip. No tetanus bacilli found. Period of incubation, 7 days; mild—limited to face and neck; so mild that diagnosis questioned; no general convulsions; treatment began second day; continued 6 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, for 3 days q. 6 hours, and following 6 days q. 12 hours, 10 c.c. at each injection. Total amount injected, 180 c.c. Sodium bromide also given. Marked erythema. Recovery.

CASE 29.—GEO. E. BREWER, Roosevelt Hospital, New York. Lacerated wound of posterior and inner right arm; caught in machinery cogs. No tetanus bacilli found. Period of incubation, 19 days; mild trismus; no dysphagia; opisthotonos 2 days later following incision; treatment began second day; continued 10 days. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum, first injection 10 c.c. into abdominal muscles, then q. 6 hours for 7 days, 10 c.c. On eighth and ninth days 2 injections 10 c.c. and on tenth day 1. Total amount injected, 340 c.c. Gradual improvement. Recovery in 47 days.

CASE 30.—GEO. E. BREWER, Roosevelt Hospital, New York. Age 28. Elliptical incision, site of appendectomy wound 5 years old. Incision for ventral hernia. No tetanus bacilli found. Period of incubation, 11 days; eleventh day, trismus; twelfth day, rigidity of arms and neck; very weak; later same day total rigidity; treatment began first day; continued 1 day. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum, 4 injections, 15 c.c. q. 4 hours into abdomen. Total amount injected, 60 c.c. Death on third day.

CASE 31.—B. F. CURTISS, Bellevue Hospital, New York. Age 43. Compound comminuted gunshot wound of anterior side of foot. No tetanus bacilli found. Period of incubation, 7 days; stiffness lower jaw, next day almost complete trismus, by night stiffness of back; general convulsions; third day very severe; controlled by chloroform; treatment began first day; continued 3 days. Subcutaneous injection of antitoxic serum, first day, at 4 P.M., 9 P.M. and 12 P.M., 20 c.c.; second day, 6 injections q. 20 c.c.; third day, 20 c.c. q. 4 hours. Total amount injected, 300 c.c. Death on third day.

CASE 32.—H. B. WILLIAMS, New York Hospital. Age 14. Blank cartridge wound of hand, July 4th, 1904. Tetanus bacilli found. Period of incubation, 9 days; mild at first, rapidly becoming severe; general convulsions; treatment began second day; continued 6 days. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum, second day, 6 P.M., 10 c.c., 9 P.M., 15 c.c., 12 P.M., 15 c.c.; third day, 6 A.M., 10 c.c., 12 M., 40 c.c.; fourth day, 40 c.c.; sixth day, 2 injections of 30 c.c.; seventh day, 30 c.c. Total amount injected, 220 c.c. Death; for 36 hours before death no convulsions—just before death opisthotonos and severe spasm.

CASE 33.—H. B. WILLIAMS, New York Hospital. Age 38. Hand crushed while working in streets. No tetanus bacilli found. Period of incubation, 3 days; mild at first, then very severe; general convulsions; treatment began second day; continued 1 day. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum, 20 c.c. at 10 A.M., 12:30 P.M., and 10 P.M. Total amount injected, 60 c.c. Death on second day.

CASE 34.—H. B. WILLIAMS, New York Hospital. Age 13. Punctured wound of foot. No tetanus bacilli found. Period of incubation, 9 days; trismus, retraction and stiffness of neck; treatment began on eighth day; continued 6 days. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum, eighth day, 25 c.c.; ninth, 20 c.c.; tenth, 25 c.c.; eleventh, 20 c.c., 25 c.c.; twelfth, 20 c.c.; thirteenth, 20 c.c. Total amount injected, 155 c.c. Gradual improvement; discharged well after 31 days' sickness (27 days after admission).

CASE 35.—J. P. WARBASSE, German Hospital, Brooklyn, N. Y. Age 8. Blank cartridge wound of hand. No tetanus bacilli found. Period of incubation, 6 days; trismus and opisthotonos; $T = 104^{\circ}$; treatment began on first day; continued 1 day. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum 10 c.c. every 2 hours. Total amount injected, 120 c.c. T° rose to 108.6° before death on third day. Death.

CASE 36.—J. P. WARBASSE, German Hospital, Brooklyn, N. Y. Age 43. Supravaginal hysterectomy, double oöphorectomy. Incision, 4.5 inches. No tetanus bacilli found. Period of incubation, 6 days; trismus, dysphagia, rigidity of cervical muscles, later opisthotonos; general convulsions; treatment began on first day; continued 1 day. New York City Board of Health's antitoxin used.

Subcutaneous injection of antitoxic serum, 3 injections, q. 8 hours, 20 c.c. Total amount injected, 60 c.c. Death.

CASE 37.—J. P. WARBASSE, German Hospital, Brooklyn, N. Y. Age 14. Gunshot wound of foot. No tetanus bacilli found. Period of incubation, 7 days; characteristic; treatment began on first day; continued 1 day. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum, 3 injections, 20 c.c. q. 8 hours. Total amount injected, 60 c.c. Death.

CASE 38.—J. P. WARBASSE, German Hospital, Brooklyn, N. Y. Age 13. Punctured wound of sole of foot by nail. No tetanus bacilli found. Period of incubation, 4 days; pain in chest, then trismus, pain in neck with rigidity; general convulsions; treatment began on third day. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum, injections q. 6 hours. How long not stated. Recovery.

CASE 39.—J. P. WARBASSE, German Hospital, Brooklyn, N. Y. Age 12. Lacerated wound, hand. No tetanus bacilli found. Characteristic. New York City Board of Health's antitoxin used. Subcutaneous injections of antitoxic serum administered daily, given in injections of 20 c.c. q. 12 hours. Length of period of treatment omitted. Death.

CASE 40.—J. P. WARBASSE, German Hospital, Brooklyn, N. Y. Age 10. Blank cartridge wound of right hand. No tetanus bacilli found. Period of incubation, 8 days; slow development; cramp-like pain between scapulae; then stiffness legs, right arm; trismus. On entering hospital right arm in convulsions. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c. q. 6 hours. How long not mentioned. Recovery.

CASE 41.—J. P. WARBASSE, German Hospital, Brooklyn, N. Y. Age 28. Punctured wound left foot; nail. No tetanus bacilli found. Period of incubation, 7 days; virulent; stiffness of muscles of neck and face, trismus, involuntary defecation. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum, details not furnished. T.° rose to 108.6° before death on third day.

CASE 42.—CHAS. H. GOODRICH, Methodist Episcopal Hospital, Brooklyn, N. Y. Age 23. Right hand lacerated by buzz saw. No tetanus bacilli found. Period of incubation, 14 days; pain in hand, stiffness jaws, neck and abdomen; head retracted; general convulsions; treatment began on third day; continued 3 days. Gibier's antitoxin used. Subcutaneous injection of antitoxic serum third, fourth, and fifth days; 9 doses, 1 q. 8 hours, 8¼ c.c. Total amount injected, 75 c.c. Serum treatment discontinued as patient grew worse. Death on seventh day.

CASE 43.—CHAS. H. GOODRICH, Methodist Episcopal Hospital, Brooklyn, N. Y. Age 29. Punctured wound of foot from nail. Period of incubation, 6 days; rigidity of jaw; advanced rapidly; pain in back; dysphagia; opisthotonos; general convulsions; treatment began on fourth day; continued 2 days. New York City Board of Health's antitoxin used. Subcutaneous injection of antitoxic serum, fourth day, 2 injections, 20 c.c. and 12 c.c. Fifth day, 2 injections 20 c.c. each. Total amount injected, 72 c.c. Death on sixth day in sudden and severe convulsions.

CASE 44.—CHAS. H. GOODRICH, Methodist Episcopal Hospital, Brooklyn, N. Y. Age 56. Colectomy for cancer splenic flexure. Anastomosis with bobbin of raw potato. No tetanus bacilli found. Period of incubation, 10 days; eighth day, great abdominal pain; tenth day, choking sensation and dysphagia; trismus and neck rigidity followed; general convulsions; treatment began on first day; continued 2 days. Brooklyn Health Department's antitoxin used. Subcutaneous injection of antitoxic serum, first day, in evening, 20 c.c.; second day, A.M., 20 c.c.; P.M., 30 c.c. Total amount injected, 70 c.c. Death during tenth severe general convulsion on second day.

CASE 45.—HALL AND CLOPTON, St. Louis; private. Age 55. Penetrating wound of sole of right foot. No tetanus bacilli found. Period of incubation, 13 days; spasms in right leg extending up into thigh; next, trismus with dysphagia; symptoms of mild type; treatment began on first day; continued 10 days.

Subcutaneous injection of antitoxic serum, 1 injection of 10 c.c. daily for 10 days. Total amount injected, 1000 c.c. Wound excised first day. Disease lasted 12 days. Mild. Recovery.

CASE 46.—J. C. MORFIT, St. Louis; private. Age 30. Penetrating wound of toe; rusty nail. No tetanus bacilli found. Period of incubation, 7 days; severe; extreme trismus; treatment began on first day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 1 injection, "large amount." Very severe case. Death on first day.

CASE 47.—J. C. MORFIT, Mullanphy Hospital, St. Louis. Age 19. Gunshot wound left hand. Had intercurrent tonsillitis. Tetanus bacilli found. Period of incubation, 11 days; risus sardonicus, dysphagia, stiffness of neck, abdomen and extremities; opisthotonos; general convulsions; treatment began on first day; continued 10 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, first day, 6 injections; second day, 3; third day, 2; fourth day, 2; fifth to tenth days, 1 daily, all of 10 c.c. Total amount injected, 190 c.c. Recovery. "I have seen a more severe case recover without any treatment."

CASE 48.—WM. J. TAYLOR, St. Agnes Hospital, Philadelphia. Age 8. Punctured wound (healed) in palm of hand; nail. No tetanus bacilli found. Period of incubation, 6 days; entered hospital second day; stiffness of neck and back, trismus, marked convulsions, opisthotonos, risus sardonicus; general convulsions; treatment began on first day; continued 1 day. Subcutaneous injection of antitoxic serum, first day, 30 c.c. about noon. Total amount injected 30 c.c. Discharged cured on third day.

CASE 49.—JAS. TYSON, Pennsylvania Hospital, Philadelphia. Age 53. Healed punctured wound plantar surface right foot. No tetanus bacilli found. Period of incubation, 9 days; trismus, rigidity of cervical muscles and those of jaw, back and abdomen; admitted fifth day; treatment began on fifth day; continued 1 day. Mulford's antitoxin used. Subcutaneous injection of antitoxic serum, 30 c.c. given about wound, and 30 c.c. and later 60 c.c. into abdomen. Total amount injected, 120 c.c. Death 24 hours after admission.

CASE 50.—ALFRED STENGEL, Pennsylvania Hospital, Philadelphia. Age 27. Burn of arm (coal oil). No tetanus bacilli found. Period of incubation, 25 days; admitted 30 days after injury; profound trismus; slightest noise would produce general convulsions with opisthotonos; general convulsions; treatment began fifth day; continued 1 day. Mulford's antitoxin used. Subcutaneous injection of antitoxic serum, 3 injections 40 c.c. each; 9 A.M., 12 M. and 4 P.M. Total amount injected, 120 c.c. After 3 doses, carbolic acid injections given. Gradual recovery. Well in 25 days.

CASE 51.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore. Age 52. Punctured wound sole of foot, rusty nail. Period of incubation, 7 days; admitted second day; stiffness neck and jaws; almost absolute trismus; risus sardonicus; rigid abdominal muscles; treatment began on second day; continued 1 day. Subcutaneous injection of antitoxic serum, 30 c.c. injected into axilla and 20 c.c., summary. Total amount injected, 50 c.c. Death on day of admission.

CASE 52.—C. A. PORTER, Massachusetts General Hospital. Age 55. Compound fracture right ankle. Leg amputated day before first symptoms. Period of incubation, 6 days; rigid neck; T. 105°; dysphagia; no general convulsions; treatment began on second day; continued 1 day. Subcutaneous injection of antitoxic serum, 20 c.c. q. 4 hours. Death on third day.

CASE 53.—C. A. PORTER, Massachusetts General Hospital. Age 29. Multiple lacerated dynamite wounds from knee to jaw right side of body. No tetanus bacilli found. Period of incubation, 7 days; dysphagia, rapid increase in severity; T. 100.2°, P. 68, R. 22; treatment began on first day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum 20 c.c. q. 4 hours. Total amount injected, 80 c.c. Death in 17 hours.

CASE 54.—C. A. PORTER, Massachusetts General Hospital. Age 16. Blank cartridge wound of finger. Period of incubation, 6 days; opisthotonos, diaphragmatic breathing, trismus, dysphagia; T. 100.4°, P. 124, R. 22; treatment

began second day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 30 c.c. in pectoral region repeated in 6 hours and again in 4 hours. Total amount injected, 90 c.c. Death in 18 hours.

CASE 55.—C. A. PORTER, Massachusetts General Hospital. Age 11. Blank cartridge wound of palm. Tetanus bacilli found. Period of incubation, 9 days; slight risus, slight retraction of head; T. 100.5°, P. 84; treatment began on second day; continued 4 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c. q. 4 hours increasing to 20 c.c. q. 2 hours on last day. Death on sixth day.

CASE 56.—C. A. PORTER, Massachusetts General Hospital. Age 36. Blank cartridge wound left hand. No tetanus bacilli found. Period of incubation, 7 days; masseters, neck and abdominal muscles stiff; T. 99.8°, P. 70, R. 28; treatment began on second day; continued 2 days. Subcutaneous injection of antitoxic serum, 20 c.c. q. 4 hours. Doubled amount on second day. Death on third day.

CASE 57.—C. A. PORTER, Massachusetts General Hospital. Age 10. Blank cartridge wound left side thorax. No tetanus bacilli found. Period of incubation, 7 days; convulsions; no lung symptoms or dyspnoea; T. 102°, P. 150, R. 35; general convulsions; treatment began on second day; continued 1 day. Subcutaneous injection of antitoxic serum, 5 c.c., 15 c.c., 20 c.c. q. 3 hours. Death on second day.

CASE 58.—C. A. PORTER, Massachusetts General Hospital. Age 11. Blank cartridge wound, left palm. Tetanus bacilli found. Period of incubation, 7 days; trismus and dysphagia; T. 99.8°, P. 92, R. 18; treatment began on second day; continued 3 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 40 c.c. on entrance, 10 c.c. q. 3 hours. Death on fourth day. T. 108°.

CASE 59.—C. A. PORTER, Massachusetts General Hospital. Age 13. Compound fracture of forearm. No tetanus bacilli found. Period of incubation, 7 days; very severe; T. 104.8°, P. 140, R. 27; general convulsions every 20 seconds; treatment began on second day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 30 c.c. after amputation of arm, 20 c.c. 6 hours later. Total amount injected, 50 c.c. Death in 23 hours.

CASE 60.—C. A. PORTER, Massachusetts General Hospital. Age 27. Punctured wound foot; nail. No tetanus bacilli found. Period of incubation, 14 days; mild at first, gradually increasing; T. 104°, P. 72, R. 23; no general convulsions; treatment began on second day. Subcutaneous injection of antitoxic serum, 20 c.c. q. 6 hours. Gradual recovery in 23 days.

CASE 61.—C. A. PORTER, Massachusetts General Hospital. Age 9. Blank cartridge wound, hand. No tetanus bacilli found. Period of incubation, 10 days; trismus, spasms of flexors of hand, opisthotonos on stimulation; T. 100.6°, P. 112, R. 25; general convulsions; treatment began on second day; continued 4 days. Subcutaneous injection of antitoxic serum, every 4 hours for 4 days in varying amounts. Discharged after 33 days.

CASE 62.—C. A. PORTER, Massachusetts General Hospital. Age 28. Blank cartridge wound, left hand. Period of incubation, 7th day; trismus and rigidity muscles neck and abdomen; T. 100°, P. 80, R. 22; no general convulsions. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c. q. 4 hours. Recovery in 26 days. Never had convulsions.

CASE 63.—JAMES BELL, Royal Victoria Hospital, Montreal. Age 29. Punctured wound of sole of foot; rusty nail. Period of incubation, 6 days; stiffness of jaw and back muscles; jolting caused spasms; later, spasms of muscles of abdomen and extremities; risus sardonius; general convulsions; treatment began on fifth day; continued 2 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, first day, 10 c.c. subcutaneously; second day, 10 c.c. subcutaneously. Total amount injected, 20 c.c. Death on seventh day.

CASE 64.—JAMES BELL, Royal Victoria Hospital, Montreal. Age 18. Punctured wound of foot; nail. Period of incubation, 8 days; stiffness of jaw,

dysphagia, constricted feeling in chest; treatment began on fifth day; continued 6 days. Gibier's and Roux's antitoxin used. Subcutaneous injection of antitoxic serum, sixth day: 11:30 A.M., 1 c.c.; 5:30 P.M., 1 c.c. Seventh day: 11 A.M., 1 c.c.; 6 P.M., 10 c.c. Eighth day: 6 A.M., 10 c.c.; 12 M., 25 c.c.; 6 P.M., 25 c.c. Ninth day: 12 P.M., 25 c.c.; 6 A.M., 25 c.c.; 12 M., 10 c.c. Tenth day: 12 P.M., 10 c.c.; 12 M., 25 c.c.; 6 P.M., 25 c.c. Eleventh day: 12 P.M., 85 c.c. Total amount injected, 278 c.c. Death on eleventh day.

CASE 65.—JAMES BELL, Royal Victoria Hospital, Montreal. Age 42. Compound fracture tibia and fibula left leg. Tetanus bacilli found. Period of incubation, 10 days; stiffness of jaws, dysphagia, risus sardonius, rigidity of abdominal muscles, rectal tenesmus, spasms of muscles of face; treatment began on second day; continued 19 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, second day: 3 P.M., 30 c.c.; 11 P.M., 20 c.c. Third to eighth days, 20 c.c. daily; ninth day, 10 c.c.; fifteenth day, 20 c.c.; eighteenth day, 20 c.c.; twenty-first day, 20 c.c. Total amount injected, 240 c.c. Recovery in 44 days.

CASE 66.—JAMES BELL, Royal Victoria Hospital, Montreal. Slight superficial cut on palm of left hand. No tetanus bacilli found. Period of incubation, 12 days; dysphagia, face swollen, backache, constricted feeling in chest, opisthotonos; injured hand flexed at wrist, thumb adducted; general convulsions; treatment began on second day; continued 1 day. Subcutaneous injection of antitoxic serum, 10 c.c. into wound and 20 c.c. into right loin on admission; 12 M., 40 c.c. into left loin. Total amount injected, 70 c.c. Recovery.

CASES OF TETANUS TREATED IN HOSPITALS OR BY HOSPITAL SURGEONS WITH ANTITOXIC SERUM INJECTED INTO VARIOUS STRUCTURES.

CASE 1.—ROSSELL PARK, Buffalo General Hospital. Age 10. A punctured wound of sole of foot, by tack. Period of incubation, 8 days; marked tetanus and opisthotonos; treatment began on second day; continued 1 day. Subcutaneous injection of antitoxic serum, 30 c.c., at 7 P.M.; 23 c.c., 11 P.M. Intraneural injection, 3 c.c., into sciatic; 3 c.c., into anterior crural. Intraspinal injection at two places, each 12 c.c. Total amount injected, 83 c.c. Death one-half hour after second injection.

CASE 2.—GEO. T. VAUGHAN, Emergency Hospital, Washington, D. C. Age 25. Thumb and two fingers destroyed by burn. Dressed with ichthyol and iodoform. Period of incubation, 16 days; trismus, abdominal rigidity, opisthotonos; general convulsions; treatment began first day; continued 4 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 20 c.c. q. 4 hours for first 2 days. Intravenous injection, 1st day 10 c.c. Intracranial, 3rd and 4th days 30 c.c. daily under dura. Total amount injected, 310 c.c. Death on 4th day.

CASE 3.—H. B. GESSNER, Charity Hospital, New Orleans, La. Age 18. Railroad injury to right foot and laceration of the scalp. Period of incubation, 11 days; severe; temperature, 102°; general convulsions; treatment began on second day; continued one day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c. into foot. Intraspinal, 162 m. Total amount injected, 21 c.c. Convulsions disappeared in 10 days, cured in 34 days.

CASE 4.—S. LOGAN, Charity Hospital, New Orleans, La.; service Dr. Matas. Age 13. Toy pistol wound on right hand. Period of incubation, 8 days; mild, slight opisthotonos, few convulsions; general convulsions; treatment began on first day; continued 3 days. P. D. & Co.'s antitoxin used. Intraneural injection, perineural 50 c.c. Intraspinal injection, 10 c.c. Total amount injected, 60 c.c. Course and termination not stated.

CASE 5.—C. B. G. DE NANCREDE; private patient. Age 18. Severe injury of foot. Early manifestations of tetanus not stated. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c. q. 4 hours. Intraneural injection.

tion, at time of amputation into severed nerve trunks; intraspinal injection, at time of amputation. Amputation through middle of leg. Recovery.

CASE 6.—PATCH, Montreal General Hospital. Age 5. Traumatic amputation of thigh; bone and muscles protruding. No tetanus bacilli found. Period of incubation, 9 days; admitted second day unconscious, trismus, opisthotonos; T. 99.2°–104.4°; general convulsions, 2; treatment began second day; continued 1 hour. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c. Intraspinal injection, 20 c.c. Intracranial, 10 c.c. Total amount injected, 40 c.c. Death 1 hour after injections.

CASE 7.—PATCH, Montreal General Hospital. Age 16. Laceration of forehead. Period of incubation, 8 days; trismus and dysphagia gradually increasing for 6 days; on admission spastic gait, head retracted to left, trismus, paralysis of tongue, respiratory distress, rt. facial paralysis; treatment began on sixth day; continued 2 days. Roux's antitoxin used. Subcutaneous injection of antitoxic serum, 5 c.c. on sixth day. Intraspinal injection, sixth day, 10 c.c.; seventh day, 15 c.c. Total amount injected, 30 c.c. Improvement began 4 days after admission. Up 10 days later. Recovery.

CASE 8.—PATCH, Montreal General Hospital. Age 5. Small wound on sole of foot, healed, enclosing drop pus. No tetanus bacilli found. Period of incubation, 10 to 14 days; stiffness neck and arms in morning; 10 P.M., general convulsions, opisthotonos; next day trismus, twitching face, all muscles in tonic convulsions, T. 98°; general convulsions; treatment began second day; continued 15 hours. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c. first; intraspinal injection later, 10 c.c. Total amount injected, 20 c.c. Death 15 hours after first injection. T.° 109°.

CASE 9.—WM. M. MASTIN, Mobile City Hospital, Mobile, Ala. Age 35. Following abortion. No tetanus bacilli found. Period of incubation, 7 to 8 days; mild trismus, muscular rigidity, opisthotonos; general convulsions; treatment began on second day; continued 5 days. Mulford's antitoxin used. Subcutaneous injection of antitoxic serum, third to sixth days, 20 c.c. q. 4 to 8 hours. Intraspinal injection, second day, 20 c.c. Total amount injected, 400 c.c. Morphine and chloral also given. Recovery.

CASE 10.—DUDLEY P. ALLEN, Lakeside Hospital, Cleveland. Age 26. Blank cartridge wound, hand; healing. No tetanus bacilli found. Period of incubation, 7 days; trismus; during next 48 hours muscles of neck, back and legs rigid; treatment began first day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 5 c.c. Intracranial, 2½ c.c. into each lateral ventricle. Total amount injected, 10 c.c. T. rose from 100° to 109° (axillary). Death on fourth day.

CASE 11.—DUDLEY TAIT, French Hospital, San Francisco. Age 27. Slight abrasion received in cleaning hides. No tetanus bacilli found. Period of incubation, 6 days; acute, characteristic symptoms; entered hospital second day; treatment began second day; continued 3 days. P. D. & Co.'s antitoxin used. Intravenous injection, several of 8 c.c. on third day. Intracranial injection, second day, 1 and 1½ c.c. in each frontal lobe. Death on fourth day.

CASE 12.—DUDLEY TAIT, San Francisco; private patient. Age 26. Lacerated wound left index finger. Period of incubation, 14 days; subacute; general convulsions; treatment began on first day; continued 5 days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, first day 4 injections, 20 c.c., afterwards 2 injections daily. Intravenous injection, first day, 4 injections 1½ c.c., afterwards 2 daily. Total amount injected, 36 c.c. Death.

CASE 13.—DUDLEY TAIT, San Francisco; private patient. Age 30. Wound, right hand (stable man). No tetanus bacilli found. Period of incubation, 10 days; mild; general convulsions; treatment began first day; continued few days. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 2 injections first day, repeated daily. Intravenous injection, 2 injections first day, repeated daily. Recovery.

CASE 14.—GEO. E. BREWER, Roosevelt Hospital, New York City. Age 14. Blank cartridge wound base of left forefinger. No tetanus bacilli found. Period

of incubation, 6 days; severe trismus; head retracted; general convulsions with opisthotonos and spasms of extremities; general convulsions; treatment began first day; continued 2 days. N. Y. C. B. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, first day, 20 c.c. Intravenous injection, second day, 20 c.c. Total amount injected, 40 c.c. Death second day.

CASE 15.—GEO. E. BREWER, Roosevelt Hospital, New York City. Age 21. Infected blank cartridge wound base left forefinger. No tetanus bacilli found. Period of incubation, 8 days; some trismus, stiffness back of neck, painful dysphagia, opisthotonos; general convulsions; treatment began second day; continued 10 days. N. Y. C. B. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, second day, 4 doses; third day, 6 doses; fourth day, 2 doses; fifth day, 2 doses; sixth day, 3 doses; seventh day, 4 doses; eighth day, 3 doses; ninth day, 4 doses; tenth day, 3 doses; each 20 c.c. Intravenous injection, fifth day, 4 doses 20 c.c. Total amount injected, 640 c.c. Dyspnoea and cyanosis third day with dysphagia and strangling. No symptoms until seventh day. Then rigidity of muscles. Later became comfortable. Death twelfth day.

CASE 16.—GEO. E. BREWER, Roosevelt Hospital, New York City. Age 24. Compound fracture ulna with lacerated elbow. No tetanus bacilli found. Period of incubation, 7 days; trismus, pain back of neck, opisthotonos, involuntary micturition; treatment began first day; continued 2 days. Subcutaneous injection of antitoxin serum, first day, 60 c.c. Intravenous injection, first day, 40 c.c. with 1,000 c.c. saline solution; same second day. Total amount injected, 140 c.c. Death on second day.

CASE 17.—HENRY HEIMAN, Mt. Sinai Hospital, New York. Age 12. Penetrating wound right foot; nail. Tetanus bacilli found. Period of incubation, 11 days; severe rigidity, neck, back and legs; trismus, hyperacusis; treatment began third day; continued 8 days. N. Y. C. B. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 8 injections, 20 c.c. Intraspinal injection, 3 injections of 20 c.c. Total amount injected, 220 c.c. Recovery. Question if due to serum.

CASE 18.—A. V. MOSCHCOWITZ, Mt. Sinai Hospital, New York. Age 18. Blank cartridge, palm hand. No tetanus bacilli found. Period of incubation, 7 days; mild at first, increasing in severity; treatment began second day; continued 2 days. Antitoxin of Institute Pasteur, Paris, used. Intravenous injection, second day, 2 injections of 20 c.c. and 10 c.c. Intracranial injection, third day, 5 c.c. Total amount injected, 35 c.c. Death.

CASE 19.—WILLY MEYER, German Hospital, New York. Age 27. Appendectomy through rectus muscle. No tetanus bacilli found. Period of incubation, 10 days; trismus, pain in muscles of jaw; rigidity and pain in muscles of neck, risus sardonius, opisthotonos, dysphagia; treatment began second day; continued 6 days. Subcutaneous injection of antitoxic serum, third day, 10 c.c.; seventh and eighth days, 10 c.c.; ninth day, 15 c.c. Intraspinal injection, second day, $2\frac{1}{2}$ c.c.; third day, 10 c.c.; fifth day, 12 c.c. and 15 c.c. Total amount injected, $84\frac{1}{2}$ c.c. Gradual recovery.

CASE 20.—FRED KAMMERER, German Hospital, New York. Age 38. Appendectomy during quiescent period. Primary incision. Tetanus bacilli found. Period of incubation, 9 days; very severe, risus sardonius, rigidity muscles neck, abdomen; later paralysis muscles deglutition, rigidity of intercostals; general convulsions; treatment began first day; continued 11 days. N. Y. C. B. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, first day, 30 c.c.; sixth, seventh, eighth, ninth, tenth, eleventh days, 2 injections of 30 c.c. Intraspinal injection, second day, 15 c.c. Intravenous injection, third, fourth and fifth days, each, 30 c.c. Total amount injected, 495 c.c. Improvement for 9 days, then increase in symptoms. Death twelfth day.

CASE 21.—H. B. WILLIAMS, Hudson St. House of Relief, N. Y. City. Age 12. Blank cartridge wound left thigh; suppurating; 4th July, 1899. Period of incubation, 4 days; stiffness of thigh, 5 days later trismus, risus sardonius, opisthotonos; general convulsions; treatment began seventh day; continued 1

day. Subcutaneous injection of antitoxic serum, seventh day, 20 c.c. Intracranial injection, seventh day, 5 c.c. into each frontal lobe. Total amount injected, 30 c.c. Death on eighth day.

CASE 22.—H. B. WILLIAMS, Hudson St. House of Relief, N. Y. City. Age 13. Blank cartridge wound base of left thumb. Dressed 5 hours after injury; no subsequent dressing. Period of incubation, 5 days; sudden stiffness jaw, next day mild opisthotonos and marked trismus; general convulsions; treatment began second day; continued 1 day. N. Y. C. B. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 50 c.c. Intracranial injection, 10 c.c. into each lateral ventricle. Total amount injected, 70 c.c. Death on third day.

CASE 23.—H. B. WILLIAMS, New York Hospital. Age 54. Compound fracture of leg. Amputated at hospital 6 days later. No tetanus bacilli found. Period of incubation, 9 days; trismus; treatment began first day; continued 1 day. N. Y. C. B. of H.'s antitoxin used. Intravenous injection, 20 c.c. in 450 c.c. salt solution. Intracranial injection into each lateral ventricle. Total amount injected, 20 c.c. + . Death on second day. Leg amputated 6 days after injury.

CASE 24.—H. B. WILLIAMS, New York Hospital. Age 17. Blank cartridge wound palm right hand. No tetanus bacilli found. Period of incubation, 6 days; trismus and mild risus sardonius; treatment began second day; continued 11 days. N. Y. C. B. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, second day, into chest and abdomen, 20 c.c.; fourth day, q. 6 hours, 20 c.c., 10 c.c., 20 c.c.; fifth day, 20 c.c. Intraspinal injection, sixth to twelfth days inclusive, daily 20 c.c. Intravenous injection, third day, 50 c.c. Total amount injected, 290 c.c. Death on twelfth day.

CASE 25.—R. R. CANNA, King's County Hospital, Brooklyn. Age 40. Rusty nail from stable into foot. No trouble locally with wound. Tetanus bacilli found. Period of incubation, 4 days; entered hospital seventh day, trismus had been present 3 days, opisthotonos; general convulsions; treatment began fourth day; continued 1 day. N. Y. C. B. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 20 c.c. Intraspinal injection, 40 c.c. Total amount injected, 60 c.c. Foot amputated; death in coma day after admission.

CASE 26.—R. R. CANNA, King's County Hospital, Brooklyn. Age 22. R. R. traumatic amputation right thigh. Tetanus bacilli found. Period of incubation, 8 days; difficulty in opening mouth; trismus followed delirium; opisthotonos; treatment began first day; continued 15 days. N. Y. C. B. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 40 c.c. first day. Intraspinal injection, 15 c.c., first day; 20 c.c. each day subsequently until death. Total amount injected, 335 c.c. Death on fifteenth day.

CASE 27.—GEO. PICKERELL, U. S. N., U. S. Naval Hospital, San Juan, Porto Rico. Age 22. Punctured wound inner side right leg, just below knee. Period of incubation, 10 days; ninth day coryza with soreness and stiffness of jaws; tenth day symptoms marked; eleventh day pronounced trismus, on auscultation murmur over muscles jaw, neck and chest; general convulsions, eleventh day, 1 of fifteen minutes, thirteenth day, 3; treatment began second day; continued 6 days. "French" antitoxin used. Subcutaneous injection of antitoxic serum, second day, 10 c.c.; third day, 20 c.c.; fourth, fifth, sixth, each 20 c.c. Intracranial injection, third day right lateral ventricle and subdural, each 3 c.c. Total amount injected, 100 c.c. After fourth day gradual improvement. Recovery 55 days after injury.

CASE 28.—J. B. CARNETT, Philadelphia Hospital. Age 9. Nail perforated shoe; punctured wound of sole. No tetanus bacilli found. Period of incubation, 6 days; admitted second day; trismus 24 hours' duration; general convulsions 12 hours before; general spastic condition of muscles; general convulsions; treatment began second day; continued few hours. Mulford's antitoxin used. Subcutaneous injection of antitoxic serum, 30 c.c. Intraneural injection, 30 c.c. into great sciatic at gluteal fold. Intraspinal injection, 35 c.c. Total amount injected, 95 c.c. Given at one time under anæsthetic. Death 3 hours later.

CASE 29.—JAS. TYSON, Pennsylvania Hospital, Philadelphia. Age 27. No wound except that of tongue bitten during first convulsion 4 days before. Retained placenta found at autopsy. No tetanus bacilli found. On admission, trismus, general muscular rigidity, increased reflexes; general convulsions; treatment began fourth day; continued 1 day. Mulford's antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c., later, 20 c.c. Intraspinal injection, 20 c.c., later, 30 c.c. Total amount injected, 80 c.c. Death 24 hours after admission into hospital.

CASE 30.—JAS. TYSON, Pennsylvania Hospital, Philadelphia. Age 26. Small punctured wound right foot; rusty nail. No tetanus bacilli found. Period of incubation, 6 days; only painful mastication; reflexes increased; seventh day, general muscular rigidity; ninth day, convulsions; general convulsions; treatment began first day; continued 2 days. Mulford's antitoxin used. Subcutaneous injection of antitoxic serum, first day, 30 c.c. over sciatic nerve; later, again, 30 c.c.; second day, q. 4 hours 60 c.c. Intraspinal injection, first day, 30 c.c. Total amount injected, 420 c.c. Death on third day.

CASE 31.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore, Md. Age 43. Punctured wound left great toe; rusty nail. Tetanus bacilli found. Period of incubation, 8 days; stiffness muscles jaw and neck; progressed rapidly to opisthotonos; general convulsions; treatment began second day; continued 5 days. Subcutaneous injection of antitoxic serum deep into thigh muscles twice daily for several days, 10 c.c. Intracranial injection, once, 5 c.c. into each frontal lobe. Total amount injected, 90 c.c. Death on seventh day.

CASE 32.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore, Md. Age 50. Gangrene right foot from frost bite; amputation. No tetanus bacilli found. Five days after admission retraction head; 2 hours later opisthotonos, risus sardonicus; 3 hours later general convulsions; injection of antitoxic serum, 5 c.c. into thigh muscles first day and 15 c.c. second day, 5 c.c. under skin. Intravenous injection, 10 c.c. second day. Total amount injected, 35 c.c. Death on second day.

CASE 33.—NATHAN JACOBSON, St. Joseph's Hospital, Syracuse, N. Y. Blank cartridge wound right hand July 4th, 1899. Wound opened on admission to hospital and wad removed. No tetanus bacilli found. Period of incubation, 7 days; admitted on fourth day with trismus, stiffness neck muscles and general convulsions; general convulsions; treatment began fourth day; continued 2 days. Subcutaneous injection of antitoxic serum, fourth day, 2 injections, 10 c.c. Intracranial injection, fifth day, twice, 10 c.c. Total amount injected, 40 c.c. Death, 7 A.M. on sixth day.

CASE 34.—H. B. WILLIAMS, Hudson St. House of Relief, N. Y. City. Age 22. Punctured wound left foot; rusty nail. No tetanus bacilli found. Period of incubation, 5 days; stiffness of neck and jaw muscles; treatment began fifth day; continued 1 day. N. Y. City Health Department's antitoxin used. Subcutaneous injection of antitoxic serum, 1 injection, 10 c.c. Intraspinal injection, 1 injection 10 c.c. Total amount injected, 20 c.c. Death on sixth day of disease; one day after admission.

CASE 35.—C. A. PORTER, Massachusetts General Hospital. Age 13. Blank cartridge wound, left palm. Tetanus bacilli found. Period of incubation, 4 days; pain in back of neck, trismus; risus sardonicus; convulsions; general convulsions; treatment began on fourth day; continued 1 day. P. D. & Co.'s antitoxin used. Intraneural injection, median and ulnar at wrist, 1 c.c.-3 c.c. Intraspinal injection, 11 c.c. twice. Total amount injected, 26 c.c. Death 16 hours after admission.

CASE 36.—C. A. PORTER, Massachusetts General Hospital. Age 10. Cannon cracker wound, right arm. Tetanus bacilli found. Period of incubation, 4 days; trismus, convulsions, dysphagia; T. 100.2°, P. 110, R. 30; general convulsions; treatment began second day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection about wound. Intraneural injection into roots of brachial plexus. Death 16 hours after admission.

CASE 37.—C. A. PORTER, Massachusetts General Hospital. Age 15. Blank cartridge wound, right palm. Tetanus bacilli found. Period of incubation, 7 days; admitted second day; trismus, risus sardonicus, convulsions, pain in neck and abdomen, diaphragmatic breathing; general convulsions; treatment began second day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum every 4 hours. Intraneural injection, median and ulnar at wrist, $4\frac{1}{2}$ c.c. each. Intraspinal injection every 6 hours. Death 17 hours after admission.

CASE 38.—C. A. PORTER, Massachusetts General Hospital. Age 17. Knife cut second and third fingers. Period of incubation, 3 weeks; stiffness in jaws and neck, pain in back; T. 102.2° , P. 90; general convulsions; treatment began on second day; continued 1 day. Intraneural injection into brachial plexus, 5 c.c. Intraspinal injection, 10 c.c. Total amount injected, 15 c.c. Death on third day.

CASE 39.—C. A. PORTER, Massachusetts General Hospital. Age 17. Wound right leg, cannon cracker. Tetanus bacilli found. Period of incubation, 7 days; general slight rigidity, marked trismus; T. 101° , P. 96, R. 28; treatment began third day; continued 2 days. P. D. & Co.'s and Massachusetts State B. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 20 c.c. Intravenous injection, 30 c.c. in salt solution; 50 c.c. q. 6 hours, second day. Total amount injected, 200 c.c. Death 48 hours after admission.

CASE 40.—C. A. PORTER, Massachusetts General Hospital. Age 17. Blank cartridge wound of hand. Tetanus bacilli found. Period of incubation, 7 days; severe general convulsions; T. 102.8° , P. 152, R. 28; general convulsions; treatment began on first day; continued 2 hours. Subcutaneous injection of antitoxic serum, 10 c.c. Intracranial injection, 3 c.c., into each lateral ventricle. Total amount injected, 16 c.c. Death in $2\frac{1}{4}$ hours.

CASE 41.—C. A. PORTER, Massachusetts General Hospital. Age 33. Punctured wound of foot; nail. No tetanus bacilli found. Period of incubation, 5 days; trismus, moderate degree; T. 99.2° , P. 88, R. 22; general convulsions; treatment continued 3 days. Subcutaneous injection of antitoxic serum, 10 c.c. q. 4 hours. Intracranial injection, 3 c.c., into each lateral ventricle, second day. Total amount injected, 186 c.c. Death 72 hours after admission.

CASE 42.—C. A. PORTER, Massachusetts General Hospital. Age 73. Frozen toe. No tetanus bacilli found. Period of incubation, 2 weeks; trismus, risus sardonicus; general convulsions; treatment began first day; continued 8 hours. Pasteur Institute antitoxin used. Intravenous injection, 40 c.c., twice. Intracranial injection, 3 c.c. into each frontal lobe and 2 c.c. under dura. Total amount injected, 90 c.c. Death 8 hours after admission.

CASE 43.—C. A. PORTER, Massachusetts General Hospital. Age 56. Nail wound, right heel. Period of incubation, 2 weeks; risus and tense abdomen; no general convulsions; treatment began fourth day. Subcutaneous injection of antitoxic serum, 20 c.c. Intraneural injection, 1 c.c. into anterior crural and sciatic. Death on fifteenth day. Not due to tetanus but to bed sores, etc.

CASE 44.—C. A. PORTER, Massachusetts General Hospital. Age 18. Machine crushed second and third fingers. Tetanus bacilli found. Period of incubation, 13 days; trismus; pain in abdomen; T. 101.6° , P. 90, R. 24; general convulsions; treatment began second day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c. q. 12 hours. Intraneural injection, musculospiral, median, and ulnar nerves injected, 10 c.c. each. Intraspinal injection, 10 c.c. twice. Total amount injected, 60 c.c. +. Recovery. Discharged thirtieth day.

CASE 45.—W. J. ROE, Jefferson Medical College Hospital. Age 14. Appendectomy during quiescent period. No tetanus bacilli found. Period of incubation, 9 days; dull pain in head and neck, trismus, retraction of head, risus sardonicus, opisthotonos, dysphagia, tonic rigidity muscles of abdomen and extremities; general convulsions; treatment began first day; continued 6 days. Mulford's antitoxin used. Subcutaneous injection of antitoxic serum, 1230 c.c. Intraspinal injection, 175 c.c. antitoxin and 13 c.c. of a 25 per cent.

MgSO₄ solution. Intravenous injection, 90 c.c. Total amount injected, 1495 c.c. Death.

CASE 46.—JAMES BELL, Royal Victoria Hospital, Montreal. Lacerated wrist; glass. Tetanus bacilli found. Period of incubation, 11 days; stiffness and numbness in fingers of injured arm; next day, trismus; fingers flexed into palm; treatment began first day; continued 18 days. Subcutaneous injection of antitoxic serum, first, second and third days, 20 c.c.; fourth to seventh days, 60 c.c. daily. Intraspinial injection, seventeenth day, 10 c.c.; eighteenth day, 10 c.c. Total amount injected, 320 c.c. Recovery in 31 days.

CASE 47.—JAMES BELL, Royal Victoria Hospital, Montreal. Age 9. Contusion and laceration of skin over tibia. Tetanus bacilli found. Period of incubation, 47 days; sore tongue, weak, backache, spastic condition lower extremities and retraction of head; general convulsions; treatment began *first day after injury*, 4 days after first symptoms; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 5 c.c. *first day after injury as a prophylactic*; fourth day of disease, 10 c.c. Intraneural injection, 7 c.c. into anterior crural. Intraspinial injection, 7 c.c. Total amount injected, 29 c.c. Death on fifth day.

CASE 48.—JAMES BELL, Royal Victoria Hospital, Montreal. Age 5. Infected vaccination wound. Tetanus bacilli found. Period of incubation, 23 days; stiffness arm and jaw, neck stiff, painful, sternomastoid contracted (operation), opisthotonos, numerous spasms; general convulsions; treatment began first day; continued 1 day. P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 10 c.c., 4 c.c., 10 c.c. Intraneural injection, 4 c.c. into sheath of musculo-spiral, musculo-cutaneous, and ulnar; enough to swell median 3 times its natural size was injected. Intraspinial injection, 4 c.c.; later, 4 c.c. by cervical puncture; still later, 10 c.c. as above. Intravenous injection, 4 c.c. Total amount injected, 58 c.c. +. Death on second day.

CASES OF TETANUS TREATED IN HOSPITALS OR BY HOSPITAL SURGEONS ADMINISTERED BY INTRASPINAL INJECTION WITH ANTITOXIC SERUM.

CASE 1.—R. MATAS, New Orleans; private patient. Age 24. Vaccination. Period of incubation, 17 days; severe tonic spasm of all voluntary and respiratory muscles; treatment began first day. P. D. & Co.'s antitoxin used. Intraspinial injection of antitoxic serum administered daily, 50 c.c. Total amount injected, 50 c.c. Result not stated.

CASE 2.—DUDLEY P. ALLEN, Lakeside Hospital, Cleveland, Ohio. Age 10. Lacerated wound left heel; cut with glass 4 weeks before admission, nearly healed. Period of incubation, 26 days; trismus, neck arched, opisthotonos; hypersensitive; general convulsions; treatment began third day; continued 12 days. P. D. & Co.'s antitoxin used. Intraspinial injection of antitoxic serum administered daily, 10 c.c. q. 6 hours for 5 days; 10 c.c. q. 8 hours for 1 day; 10 c.c. once daily for 6 days. Total amount injected, 290 c.c. Left hospital in 4 weeks, well.

CASE 3.—DUDLEY P. ALLEN, Lakeside Hospital, Cleveland, Ohio. Age 9. Boy running barefoot, number scratches and cuts on feet. Tonic convulsions, head thrown back, opisthotonos, extremities rigid; general convulsions; treatment began first day; continued 5 days. P. D. & Co.'s antitoxin used. Intraspinial injection of antitoxic serum administered daily, 10 c.c. q. 8 hours. Total amount injected, 150 c.c. Death on fifth day.

CASE 4.—DUDLEY P. ALLEN, Lakeside Hospital, Cleveland, Ohio. Age 14. Small punctured wound right foot; nail. No tetanus bacilli found. Period of incubation, 8 days; trismus, opisthotonos, extremities rigid; treatment began first day; continued 36 hours. P. D. & Co.'s antitoxin used. Intraspinial injection of antitoxic serum administered daily, 10 c.c. q. 6 hours. Total amount injected, 50 c.c. Death in 36 hours.

CASE 5.—DUDLEY P. ALLEN, Lakeside Hospital, Cleveland, Ohio. Age 34. Three unclean wounds left hand; present 3 to 4 weeks. No tetanus bacilli found. Period of incubation, 21 days; 5 days before admission, pain in back and dizziness; 3 days before, pain and stiffness of back, trismus; day before, convulsions, opisthotonos, risus sardonius; general convulsions; treatment began third day; continued 11 days. P. D. & Co.'s antitoxin used. Intraspinal injection of antitoxic serum administered daily, 10 c.c. q. 6 hours for 6 days, 240 c.c.; 10 c.c. once daily for 5 days, 50 c.c. Total amount injected, 290 c.c. Recovering.

CASE 6.—WALLACE I. TERRY, San Francisco City and County Hospital. Age 32. Punctured wound outer side plantar aspect right foot; nail. No tetanus bacilli found. Period of incubation, 7 days; stiffness neck and trismus, general convulsions, first day, opisthotonos; general convulsions; treatment began on first day; continued 4 days. P. D. & Co.'s antitoxin used. Intraspinal injection of antitoxic serum administered daily, first day, 90 c.c.; second day, 30 c.c.; third day, 20 c.c.; fourth day, 19½ c.c. Total amount injected, 159½ c.c. Death on fourth day.

CASE 7.—WILLY MEYER, German Hospital, N. Y. City. Age 37. Superficial wound over right parietal; fell from elevated railroad. Immediate suture, suppuration, reopened. Period of incubation, 5 days; trismus; 4 days later tetanus; general convulsions; treatment began on seventh day; continued 1 day. N. Y. City Board of Health's antitoxin used. Intraspinal injection of antitoxic serum administered daily, single injection, 10 c.c. Total amount injected, 10 c.c. Death next day.

CASE 8.—W. H. LUCKETT, Harlem Hospital, N. Y. City. Age 12. Blank cartridge wound right hand, July 4th. No tetanus bacilli found. Period of incubation, 7 days; stiffness in jaw, pain back neck, and right side chest; hand with claw-like contraction digits, abdominal muscles rigid; treatment began on second day; continued 12 days. N. Y. City Board of Health's antitoxin used. Intraspinal injection of antitoxic serum administered daily, second day, 8 c.c.; third day, 11 c.c.; fourth day, 12 c.c.; fifth day, 10 c.c.; sixth day, 12 c.c.; seventh day, 12 c.c.; eighth day, 15 c.c.; thirteenth day, 15 c.c. Spinal fluid withdrawn on second day, 22 m.; third day, 12 m.; fourth day, 5 m.; fifth day, 40 m.; sixth day, 2 m.; seventh day, 35 m.; eighth day, 45 m. Total, 161 m. withdrawn. Total amount injected, 92 c.c. Fifteenth day sat up in bed. Seventeenth day out of bed. Eighteenth day opened mouth. Nineteenth day discharged cured. 161 m. Cerebrospinal fluid withdrawn.

CASE 9.—W. H. LUCKETT, Harlem Hospital, N. Y. City. Age 10. Left wrist cut on broken bottle while vaulting garden fence. Period of incubation, 5 days; on fifth day abdominal pain with tonic contraction muscles; treatment began second day; continued 5 days. N. Y. City Board of Health's antitoxin used. Intraspinal injection of antitoxic serum administered daily, once daily for 5 days, 9 c.c.—14 c.c. at a dose, first withdrawing cerebrospinal fluid. Total amount of spinal fluid withdrawn, 605 m. Total amount injected, 59 c.c. Sat up thirteenth day. Discharged well seventeenth day.

CASE 10.—W. H. LUCKETT, Harlem Hospital, N. Y. City. Age 17. Blank cartridge wound, palmar surface right hand, July 4th. Period of incubation, 8 days; severe pain in head, dyspnoea, inability to articulate, muscular twitchings, trismus, rigid intercostals, abdomen rigid, left hand claw-like, contraction fingers, opisthotonos marked; general convulsions, 10; treatment began on second day; continued 4 days. N. Y. City Board of Health's antitoxin used. Intraspinal injection of antitoxic serum administered daily, once daily, each time preceded by withdrawal of cerebrospinal fluid, amounting in all to 1556 m. Injections each 18 c.c.—20 c.c. Total amount injected, 78 c.c. Gradual improvement, stiffness of legs last to disappear. Recovery in 1 month.

CASE 11.—W. H. LUCKETT, Harlem Hospital, N. Y. City. Age 24. Blank cartridge wound, left hand, July 4th. No tetanus bacilli found. Period of incubation, 10 days; trismus, abdominal muscles rigid; general convulsions 4 days later; treatment began on fourth day; continued 9 days. N. Y. City Board of Health's antitoxin used. Intraspinal injection of antitoxic serum admin-

istered daily, on fourth, fifth, sixth and twelfth days, injection preceded by withdrawal of cerebrospinal fluid amounting to 3610 m. Injections of 20 c.c. each. Total amount injected, 80 c.c. Steady improvement, sat up in bed on fifteenth day. Discharged well on twentieth day.

CASE 12.—H. G. MUDD, St. Luke's Hospital, St. Louis. Age 26. Small opening in left side scrotum, operation for varicocele. Tetanus bacilli found. Period of incubation, 7 days; very virulent; constant opisthotonos, with clonic spasms every few minutes; general convulsions; treatment began on second day; continued 1 day. Mulford's antitoxin used. Intraspinal injection of antitoxic serum administered daily, 1 injection, lumbar puncture. Total amount injected, 20 c.c. Death 16 hours after injection. Operation performed by man connected with advertising institution.

CASES OF TETANUS TREATED IN HOSPITALS OR BY HOSPITAL SURGEONS WITH ANTITOXIC SERUM ADMINISTERED BY INTRAMUSCULAR INJECTION.

CASE 1.—C. B. G. DE NANCREDÉ, University of Michigan Hospital. Age 17. Injury from moving train. Compound fracture occipital bone and compound comminuted fracture right hand. Tetanus bacilli found. Period of incubation, 11 days; difficulty in opening mouth, trismus and dysphagia, later slight localized spasm; treatment began on first day; continued 9 days. P. D. & Co.'s antitoxin used. Intramuscular injection of antitoxic serum, every 4 hours for 9 days 10 c.c. Total amount injected, 540 c.c. Amputation forearm second day. Recovery.

CASE 2.—J. SHELTON HORSLEY, Memorial Hospital, Richmond, Va. Age 25. Gunshot wound right thigh, fracturing femur. Period of incubation, 5 days; clonic spasm right thigh and leg; after 18 hours violent general convulsions; general convulsions; treatment began on first day; continued 4 days. Mulford's antitoxin used. Intramuscular injection of antitoxic serum, deep thigh injections attempting to enter nerves without exposing them, 10 c.c. every 8 hours. Total amount injected, 120 c.c. Death on fourth day.

CASE 3.—ANDREW SLOAN, St. Luke's, Utica. Age 12. Slight cartridge wound left hand. No tetanus bacilli found. Period of incubation, 11 days; trismus, tonic contractions muscles legs, back, abdomen, face, thorax, arms; second day; T. 102°-104°; treatment began on third day; continued 6 days. N. Y. S. D. of H.'s antitoxin used. Intramuscular injection of antitoxic serum administered daily, twice daily deep into thigh 60 c.c. Total amount injected, 720 c.c. Extensive urticaria. Additional medication, chloral, bromides, morphia. Gradual recovery.

CASE 4.—R. R. CANNA, King's County Hospital, Brooklyn. Age 49. Punctured wound of foot. Tetanus bacilli found. Trismus, clonic convulsions, opisthotonos. N. Y. City Board of Health's antitoxin used. Intramuscular injection of antitoxic serum administered daily, every 4 hours in doses of 20-40 c.c. Death in coma.

CASE 5.—R. R. CANNA, King's County Hospital, Brooklyn. Age 37. Punctured wound, foot; rusty nail. Tetanus bacilli found. Period of incubation, 3 days; difficult swallowing, trismus, opisthotonos; general convulsions; treatment began on third day; continued 1 day. N. Y. City Board of Health's antitoxin used. Intramuscular injection of antitoxic serum administered daily, every 4 hours 40 c.c. Total amount injected, 240 c.c. Death on fourth day in coma.

CASE 6.—R. R. CANNA, King's County Hospital, Brooklyn. Age 40. Rusty nail penetrated ball big toe. Mixed infection. Tetanus bacilli found. Period of incubation, 11 days; trismus, opisthotonos, unable to swallow; general convulsions, severe; treatment began on first day; continued 1 day. N. Y. City Board of Health's antitoxin used. Intramuscular injection of antitoxic serum 2 injections, each 40 c.c. Total amount injected, 80 c.c. Death second day after admission.

CASE 7.—ROBT. W. JOHNSON, Maryland General Hospital, Baltimore, Md. Age 18. Slight laceration palm left hand and powder burn, blank cartridge. Period of incubation, 5 days; stiffness of jaws, gradually growing worse, dysphagia; entered hospital third day; general convulsions; treatment began third day; continued 3 days. Mulford's antitoxin used. Intramuscular injection of antitoxic serum administered daily, injections 20 c.c. each; third day one, and one every 4 hours for next 3 days. Total amount injected, 380 c.c. Death on sixth day.

CASE 8.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore, Md. Age 28. Slough from burn, dorsum right foot; fell on stove during attack of epilepsy. No tetanus bacilli found. Period of incubation, 15 days; stiffness jaw muscles, gradually growing worse; general convulsions on second, fourth and fifth days; treatment began on second day; continued 16 days. Intramuscular injection of antitoxic serum administered daily, second, third, fourth, and seventh to sixteenth days 10 c.c. once daily into thigh muscles, sixth day 2 injections each 10 c.c. Total amount injected, 140 c.c. Recovery. Gradual improvement. Discharge on sixteenth day.

CASE 9.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore, Md. Age 53. Punctured wound, foot. Rusty nail. Tetanus bacilli found. Period of incubation, 9 days; stiffness muscles neck, back; trismus moderate; rigidity muscles abdomen, back and neck; dysphagia; 1 slight convulsion; treatment began on second day; continued 6 days. Intramuscular injection of antitoxic serum, twice daily 60 m., increased to 70 m. twice daily deep into thigh. Total amount injected, 65 c.c. Death on seventh day.

CASE 10.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore, Md. Age 42. Contused and encrusted wound, bridge of nose. Period of incubation, 6 days; stiffness jaw, increasing to pronounced trismus, marked delirium and restlessness, pain and difficulty in breathing; treatment began on second day; continued 6 days. Intramuscular injection of antitoxic serum, second day once, after this twice daily 10 c.c. deep into thigh. Total amount injected, 110 c.c. Death on seventh day.

CASE 11.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore, Md. Age 40. End index finger cut off, sewed on and healed. Period of incubation, 10 days; stiffness jaws and neck; risus sardonicus; admitted fourth day of disease; treatment began on fourth day; continued 2 days. Intramuscular injection of antitoxic serum, on 4th day 30 c.c., on fifth day 20 c.c., deep into thigh. Total amount injected, 50 c.c. Death on sixth day.

CASE 12.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore, Md. Age 25. Punctured wound, sole right foot, rusty nail, incised 24 hours later. No tetanus bacilli found. Period of incubation, 10 days; admitted fourth day with trismus, general clonic spasms; general convulsions; treatment began on fourth day; continued 3 days. Intramuscular injection of antitoxic serum fourth day 10 c.c. on admission, after this 10 c.c. three times daily deep into thigh. Total amount injected, 100 c.c. Death on seventh day.

CASE 13.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore, Md. Age 18. Laceration, dorsal structures, left foot. Laceration great toe right foot. Amputation left foot and great toe of right foot within 2 hours after injury. No tetanus bacilli found. Period of incubation, 7 days; stiffness jaws and neck; general convulsions, rigid abdominal muscles; general convulsions; treatment began on first day; continued 5 days. Intramuscular injection of antitoxic serum, 20 c.c. daily deep into thigh muscles. Total amount injected, 100 c.c. Death on fifth day.

CASE 14.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore, Md. Age 21. Punctured wound, outer side sole right foot. Period of incubation, 25 days; stiffness of jaws; this disappeared; cramps in abdomen, opisthotonos, no rigidity arms or legs; convulsions; general convulsions; treatment began on first day; continued 4 days. Intramuscular injection of antitoxic serum first day 50 c.c. into muscles of thigh; second day 60 c.c. into muscles of thigh; third and fourth days 20 c.c. into muscles of thigh. Total amount

injected, 150 c.c. No injections for 72 hours before death as there was apparent improvement. Then sudden death.

CASE 15.—HALSTED'S CLINIC, Johns Hopkins Hospital, Baltimore, Md. Age 8. Superficial clean granulating wound left ankle, 5 cm. in diameter, no foreign body, no suppuration. Period of incubation, 8 days; dysphagia, rigidity muscles neck, trismus, rigid abdomen; general convulsions; treatment began on second day; continued 1 day. Intramuscular injection of antitoxic serum, 20 c.c. into gluteal muscles. Total amount injected, 20 c.c. Death third day in violent convulsions.

CASE 16.—C. A. PORTER, Massachusetts General Hospital. Age 40. Traumatic amputation of fingers; axe. No tetanus bacilli found. Period of incubation, 13 days; stiffness of jaw, backache, slight risus; T. 99.2°, P. 102, R. 26; general convulsions, one; treatment began on fourth day. Intramuscular injection of antitoxic serum, 10 c.c. into deltoid q. 4 hours. Recovery in 21 days.

CASE OF TETANUS TREATED IN HOSPITALS OR BY HOSPITAL SURGEONS WITH ANTITOXIC SERUM ADMINISTERED BY INTRACEREBRAL INJECTION.

CASE 1.—Rhode Island Hospital. Age 24. Punctured wound, foot; rusty nail. Period of incubation, 6 days; continued 1 day. Intracerebral injection of antitoxic serum, 1 injection. Death 2 days after admission.

CASE OF TETANUS TREATED IN HOSPITALS OR BY HOSPITAL SURGEONS WITH ANTITOXIC SERUM ADMINISTERED BY INTRAVENOUS INJECTION.

CASE 1.—C. A. PORTER, Massachusetts General Hospital. Age 52. Following operation for removal uterine polyp. No tetanus bacilli found. Period of incubation, 7 days; risus; symptoms severe; emprosthotonos; T. 100°, P. 84, R. 17; treatment began first day; continued 2 days. Intravenous injection of antitoxic serum, 30 c.c.—40 c.c. q. 4 hours. Convulsions followed each injection. Death 48 hours after admission.

CASES OF TETANUS TREATED BY SUBCUTANEOUS INJECTION OF ANTITOXIN MADE AND FURNISHED BY THE NEW YORK STATE DEPARTMENT OF HEALTH.

CASE 1.—R. H. TEDFORD; private. Age 14. Blank cartridge wound of hand improperly dressed. Period of incubation, 5 days; general convulsions ninth day; treatment began on ninth day; continued 19 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered daily, twice daily for first 10 days, once daily thereafter. 50 c.c. Total amount injected, 1350 c.c. Effect of antitoxin doubtful. Chronic case. Recovery.

CASE 2.—F. F. SMITH; private. Age 24. Five-inch cut by buzz saw which had been cutting old wood. Period of incubation, 11 days; stiffness of left leg 3 days before any other symptom; treatment began on fifth day; continued 7 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered daily, 50 c.c. twice daily. Total amount injected, 700 c.c. Chronic case. Recovery.

CASE 3.—D. C. MORIATA; private. Age 14. Laceration of knee. Period of incubation, 18 days; stiffness of neck, jaw, face, and body; general convulsions seventh day; treatment began third day; continued 8 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered daily, 100 c.c. once daily. Total amount injected, 800 c.c. Improvement after fifth injection. Chronic case. Recovery.

CASE 4.—C. E. CAMPBELL; private. Age 30. Extensive laceration of hand by cannon fire-cracker. Period of incubation, 11 days; general convulsions

second day; treatment began second day; continued 16 days. Mulford's and N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered daily, 10 c.c. q. 4 to 6 hours. Total amount injected, 1460 c.c. Subacute case. Recovery.

CASE 5.—G. W. GREEN; private. Boy. Compound fracture of humerus under dirty conditions. Period of incubation, 6 days; general convulsions first day; treatment began first day; continued 4 hours. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 90 c.c. in divided doses. Total amount injected, 90 c.c. Very acute case. Death second day.

CASE 6.—H. E. PHELPS; private. Age 24. Slight cartridge wound of finger. Period of incubation, 8 days; general convulsions first day; treatment began first day; continued 3 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered daily, 20–50 c.c. twice daily. Total amount injected, 170 c.c. Acute. Death on third day.

CASE 7.—F. R. CALKINS; private. Slight wound, palm of hand. Period of incubation, 5 days; general convulsions within 4 hours; treatment began second day; continued 1 injection. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 20 c.c. 1 injection. Total amount injected, 20 c.c. Acute. Death on third day.

CASE 8.—HENRY FIELDS; private. Age 35. Compound Pott's fracture. Period of incubation, 10 days; trismus; general convulsions early; not severe; treatment began first day; continued 1 injection. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 20 c.c. 1 injection. Total amount injected, 20 c.c. Acute. Death on third day.

CASE 9.—FRANK H. FLOOD; private. Age 12. Laceration of great toe by bicycle. Period of incubation, 9 days; sore throat; general convulsions within 4 hours; treatment began on second day; continued 1 injection. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 50 c.c. at 1 injection. Total amount injected, 50 c.c. Acute. Death on second day, 3 hours after injection.

CASE 10.—L. S. MERRITT; private. Age 16. Toe crushed between cars. Period of incubation, 3 days; dysphagia; general convulsions within 12 hours; very severe; treatment began on third day; continued 1 injection. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 30 c.c. at 1 injection. Total amount injected, 30 c.c. Acute. Death on third day.

CASE 11.—Period of incubation, 5 days; general convulsions 12 hours after onset; very severe; treatment began second day; continued 1 injection. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin 500 c.c. at 1 injection. Total amount injected, 500 c.c. Acute. Death on second day.

CASE 12.—J. B. CONANT; private. Boy. Penetrating wound, left palm, by cartridge. Period of incubation, 10 days; general convulsions second day; treatment began second day; continued 2 days. Mulford's and P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxin administered daily, twice daily 10 c.c.—40 c.c. Total amount injected, 90 c.c. Death on eighth day.

CASE 13.—C. D. KLINE; private. Boy. Cartridge wound of hand with wad remaining in hand. Period of incubation, 8 days; general convulsions 8 hours after onset; very severe; treatment began on first day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered daily, 20 c.c. once daily. Total amount injected, 40 c.c. Death on second day.

CASE 14.—W. W. TAYLOR; private. Age 65. Laceration of elbow in machinery. Period of incubation, 10 days; spasm of biceps of injured arm; general convulsions third day, not severe; treatment began fifth day; 1 injection. P. D. & Co.'s antitoxin used. Subcutaneous injection. Total amount injected, 30 c.c. Death on eighth day.

CASE 15.—M. B. DAVIS; private. Age 26. Crushed finger. Period of incubation, 8 days; stiff neck; general convulsions third day; severe on fourth day; treatment began on twelfth day; continued 6 days. N. Y. S. D. of H.'s antitoxin

used. Subcutaneous injection of antitoxin administered daily, each injection 30-50 c.c. Total amount injected, 300 c.c. Gradual recovery.

CASE 16.—PRIVATE. Cartridge wound of hand. Period of incubation, 8 days; stiff neck and sore throat; general convulsions within 48 hours; treatment began on second day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered daily, 10 c.c. q. 12 hours. Total amount injected, 80 c.c. Death on fourth day.

CASE 17.—ALICE M. PERRIGO (head nurse), Mineola Hospital, Mineola, N. Y. End of finger crushed by hammer. Period of incubation, 10 days; possible convulsion on fifth day; treatment began on fifth day; continued 1 day. Mulford's antitoxin used. Subcutaneous injection of antitoxin administered daily, 4 injections, each 20 c.c. Total amount injected, 80 c.c. Death on sixth day.

CASE 18.—JAS. H. MCGAN; private. Crushed foot. Period of incubation, 5 days; general convulsions 48 hours; severe. Mulford's antitoxin used. Death on fourth day.

CASE 19.—CORYELL CLARK; private. Childbirth. Period of incubation, 6 days; general convulsions 36 hours; severe; treatment began second day; continued 3 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered daily, 1 injection daily, 20 c.c.—80 c.c. Total amount injected, 170 c.c. Death on sixth day.

CASE 20.—GEO. S. SKIFF; private. Nail wound of foot. Period of incubation, 7 days; general convulsions third day; treatment began third day; continued 3 days. Subcutaneous injection of antitoxin, 400 units daily. Total amount injected, 2800 units. Death on seventh day. Antitoxin doubtful, possibly diphtheritic.

CASE 21.—L. C. GREEN; private. Nail wound of foot. Period of incubation, 7 days; general convulsions second day; severe; treatment began second day; continued 1 day. Subcutaneous injection of antitoxin, 2 injections, 20 c.c. each. Total amount injected, 40 c.c. Death on fifth day.

CASE 22.—C. I. REDFIELD; private. Age 6 months. Burn, second degree, on thumb. Period of incubation, 10 days; trismus; general convulsions ninth day; only a few; treatment began on fifth day; continued 4 days. Mulford's antitoxin used. Subcutaneous injection of antitoxin, 20 c.c. once daily. Total amount injected, 80 c.c. Death on ninth day.

CASE 23.—CASSAR SMITH; private. Age 13. Lacerated wound, left knee. Malaise and trismus; general convulsions first day; treatment began first day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered, 50 c.c. daily. Total amount injected, 100 c.c. Death on second day.

CASE 24.—W. L. CLARK; private. Age 39. Nail puncture of wrist. Period of incubation, 3 days; pain in back of neck, stiffness of neck, throat and jaw muscles; pain and contraction in wrist 2 days after injury; treatment began on first day; continued 3 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered, 10 c.c. once daily. Total amount injected, 30 c.c. Recovery.

CASE 25.—W. A. LEONARD; private. Age 5½. Nail wound, left foot. Period of incubation, 7 days; sore throat, stiffness muscles of jaw, œsophagus and neck; general convulsions 48 hours; treatment began fourth day; continued 10 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin 20 c.c. q. 4 hours. Total amount injected, 560 c.c. Recovery.

CASE 26.—D. C. MORIATA, Saratoga Hospital, Saratoga Springs. Age 45. Crushed shoulder by machinery at tannery. Period of incubation, 6 days; treatment began on second day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 50 c.c. three times daily. Total amount injected, 300 c.c. Death on third day.

CASE 27.—A. E. ILETT, Watertown City Hospital, Watertown, N. Y. Age 4. Compound fracture forearm. Period of incubation, 7 days; jerky muscles and opisthotonos; general convulsions 48 hours; treatment began on first day.

continued 1 day. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 3 injections 10 c.c. each. Total amount injected, 30 c.c. Death on second day.

CASE 28.—R. GERRAIS; private. Age 7. Wound of foot by broken glass. Period of incubation, 22 days; contracture of masseters; no general convulsions; treatment began on first day; continued 1 day. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 50 c.c. 1 injection. Total amount injected, 50 c.c. Recovery. Prognosis would have been good without antitoxin.

CASE 29.—W. W. JAMIESON; private. Age 3 years, 10 months. Rusty nail-head perforated right side of head. Period of incubation, 4 days; treatment began on first day; continued 4 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 15 c.c.—50 c.c. twice daily. Total amount injected, 265 c.c. Death on fourth day.

CASE 30.—H. M. REINHARDT; private. Age 23. Old nail injury to foot. Period of incubation, 8 days; some trismus, slight pain back of neck; general convulsions fifth day; treatment began on fifth day; continued 5 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 90 c.c.—150 c.c. once daily. Total amount injected, 590 c.c. Recovery.

CASE 31.—ROBT. C. MEHNERT, German Hospital of Buffalo, N. Y. Age 16. Rusty nail wound right foot. History incomplete, admitted in convulsions; general convulsions probably quite frequent; chloroform used; continued 1 day. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 2 injections 50 c.c. each. Total amount injected, 100 c.c. Death on following day.

CASE 32.—ADOLPH HOERR; private. Age 32. Nail wound, hand. Period of incubation, 6 days; marked local contraction of hand; general convulsions 39 hours after onset; treatment began on second day; continued 3 days. N. Y. S. D. of H.'s and P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxin, 40–90 c.c. twice daily. Total amount injected, 400 c.c. Death on fifth day. Apparently hypostatic pneumonia.

CASE 33.—G. E. WALKER; private. Age 10½. Sliver in knee removed with unclean pocket-knife. Period of incubation, 12 days; general convulsions second day; treatment began fourth day; continued 6 days. N. Y. S. D. of H.'s and P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxin 10 c.c. injected once or twice daily. Total amount injected, 100 c.c. Recovery. Case questionable.

CASE 34.—H. M. REINHARDT; private. Age 7. Lacerated wound sole of foot. Period of incubation, 14 days; general convulsions first day; treatment began on first day; continued 5 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 50 c.c. twice daily. Total amount injected, 400 c.c. Recovery.

CASE 35.—A. R. WARNER, Cohoes City Hospital, Cohoes, N. Y. Age 15. Cartridge wound base of fingers. Period of incubation, 8 days; treatment began first day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 50 c.c.—100 c.c. daily. Total amount injected, 150 c.c. Death on second day.

CASE 36.—JOHN NUGENT; private. Age 60. Nail puncture left foot. Period of incubation, 9 days; general convulsions very mild on third day; treatment began on second day; continued 2 days. N. Y. S. D. of H.'s and Mulford's antitoxin used. Subcutaneous injection of antitoxin, 40 c.c.—60 c.c. daily. Total amount injected, 100 c.c. Death on third day.

CASE 37.—CHAS. C. SWEET, Samaritan Hospital, Troy, N. Y. Age 28. Crushed right hand in corn husker. Period of incubation, 12 days; no general convulsions; treatment began on second day; continued 6 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 50 c.c. q. 6 hours. Total amount injected, 900 c.c. Recovery. Serum used locally.

CASE 38.—A. F. WRIGHT; private. Age 11. Abrasion on toe. Period of incubation, 13 days; general convulsions on sixth day; continued sixteenth

day. N. Y. S. D. of H.'s and P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxin, 10 c.c.—40 c.c. for 5 injections. Total amount injected, 80 c.c. Recovery.

CASE 39.—F. E. LEWIS; private. Age 12. Clean cut on hand. Period of incubation 11 to 12 days; general convulsions; date questionable; treatment began on sixth or seventh day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 20 c.c. for 3 injections. Total amount injected, 60 c.c. Death on eighth or ninth day.

CASE 40.—CHAS. C. SWEET, Samaritan Hospital, Troy, N. Y. Age 28. Crushed right hand in corn husker. Period of incubation, 12 days; trismus and dysphagia; no general convulsions; treatment began on second day; continued 6 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin administered daily, 50 c.c. q. 6 hours. Total amount injected, 950 c.c. Gradual recovery.

CASE 41.—W. J. CARR; private. Age 34. Nail wound of foot. Period of incubation, 5 days; trismus; general convulsions on third day; treatment began on third day; continued 1 day. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxin, 1 injection 50 c.c. Total amount injected, 50 c.c. Death on fourth day.

CASE 42.—H. W. SCHLAFFI, German Hospital, Buffalo, N. Y. Age 16. Contusion and laceration of leg. Period of incubation, 12 days; treatment began second day; continued 4 days. Subcutaneous injection of antitoxin, 50 c.c. daily subcutaneously; 50 c.c. daily deep into muscle. Total amount injected, 400 c.c. Death on fifth day.

CASES OF TETANUS TREATED BY INJECTION, INTO VARIOUS STRUCTURES, OF ANTITOXIN MADE AND FURNISHED BY THE NEW YORK STATE DEPARTMENT OF HEALTH.

CASE 1.—A. W. ELTING; private. Age 35. Abortion. Period of incubation, 8 days; trismus; general convulsions seventh day; treatment began on eleventh day; continued 6 days. P. D. & Co.'s, Behring and N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, eleventh to fourteenth days q. 6 hours = 10 c.c.; fourteenth to eighteenth days 8 injections; total, 1050 c.c. Intraspinal injection, subdural, 150 c.c. Total amount injected, 1200 c.c. Some sleep and rest after some of the injections. Subacute case, slow recovery.

CASE 2.—A. W. ELTING; private. Age 57. Nail wound of foot. Period of incubation, 10 days; pain and stiffness of jaws and neck; general convulsions third day; treatment began on second day; continued 3 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 450 c.c. = 6 injections. Intraspinal injection, lumbar puncture, 3 injections, 50 c.c. each. Total amount injected, 600 c.c. Improvement following use of antitoxin. Death in spasm on fifth day from arterio-sclerosis. Tetanus was not progressing.

CASE 3.—A. W. ELTING; private. Age 14. Nail wound of foot. Period of incubation, 7 days; trismus—marked local contraction injured leg third day; general convulsions third day; treatment began on second day; continued 2 days. N. Y. S. D. of H.'s and P. D. & Co.'s antitoxin used. Subcutaneous injection of antitoxic serum, 6 injections = 270 c.c., 20 c.c.—50 c.c. Intraspinal injection, 50 c.c., 1 injection. Total amount injected, 320 c.c. Some relief from subdural injection; none from subcutaneous. Death on fourth day.

CASE 4.—C. H. TRAVELL; private. Age 27. Punctured wound of foot. Period of incubation, 7 days; stiffness muscles face and jaw; general convulsions third day; treatment began on sixth day; continued 4 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 6 injections = 270 c.c. Intraspinal injection, 2 injections, 80 c.c. Total amount injected, 350 c.c. Marked improvement from subdural injection, subcutaneous no effect. Recovery.

CASE 5.—SHELDON VORHEES; private. Age 53. Burns, third degree, legs. Period of incubation, 17 days; trismus; treatment began first day; continued 8 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 12 injections = 10 c.c.-100 c.c. each. Intraspinal injection, 1 injection 100 c.c. Total amount injected, 840 c.c. Chronic case; poor general condition. Death on eighth day.

CASE 6.—W. J. CARR; private. Age 55. Traumatic amputation of toes by threshing machine. Period of incubation, 7 days; dysphagia and trismus; general convulsions fourth day; treatment began first day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 5 c.c. twice. Intravenous injection, 100 c.c. Total amount injected, 110 c.c. Death on third day.

CASE 7.—R. M. VOSE; private. Age 45. Punctured wound of foot; nail. Period of incubation, 10 days; general convulsions 28 hours after onset; treatment began on second day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 2 injections, 20 c.c. and 30 c.c. Intraspinal injection, 1 injection 30 c.c. Total amount injected, 80 c.c. Death in 65 hours.

CASE 8.—F. J. PARMENTER and ROSWELL PARK; private. Age 9. Tack wound of foot. Period of incubation, 7 days; stiffness in neck; general convulsions third day; treatment began on second day; continued 1 day. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 1 injection. Intraneural injection, 30 c.c. Intraspinal injection, 1 injection. Total amount injected, 80 c.c. Death on third day.

CASE 9.—A. VANDERVEER; private. Age 8. Compound fracture of forearm, penetration of bone into dirt of lawn. Period of incubation, 5 days; pain in injured arm and trismus; treatment began on first day; continued 1 day. Subcutaneous injection of antitoxic serum, 50 c.c.-100 c.c. Intraspinal injection, 50 c.c. Total amount injected, 200 c.c. Death on second day.

CASE 10.—A. VANDERVEER, Albany City Hospital, Albany, N. Y. Age 6. Cartridge wound right hand. Period of incubation, 7 days; trismus; general convulsions; under chloroform most of time; treatment began second day; continued 1 day. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 50 c.c. Intraspinal injection, 30 c.c. Total amount injected, 80 c.c. Death on second day.

CASE 11.—MARSHALL CLINTON; private. Age 24. Compound comminuted fracture right femur. Period of incubation, 5 days; general convulsions first day; treatment began on first day; continued 1 day. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 40 c.c.-50 c.c. Intraspinal injection, 10 c.c. Total amount injected, 100 c.c. Death on third day.

CASE 12.—A. GILBERT; private. Age 20-22. Thrown from train, long wound right calf. Period of incubation, 6 days; general convulsions first day; treatment began first day; continued 3 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 50 c.c.-100 c.c.-100 c.c. Intraspinal injection, 7 c.c. of 25 per cent. $MgSO_4$ solution. Total amount injected, 250 c.c. +. Death on third day.

CASE 13.—JOHN W. RILEY; private. Age 26. Crack in left thumb. Period of incubation, 11 days; spasm of masseters and neck muscles; general convulsions second day; treatment began first day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 30 c.c., 50 c.c., 70 c.c., 50 c.c. Intraspinal injection, 50 c.c. Total amount injected, 250 c.c. Death on second day.

CASE 14.—MARSHALL CLINTON; private. Age 14. Wound of foot with pitchfork. Period of incubation, 12 days; stiffness of jaw and neck; general convulsions second day; treatment began second day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 14 injections, 50 c.c. each. Intraneural injection, 5 c.c. Intraspinal injection, 5 c.c., 6 c.c. Total amount injected, 716 c.c. Recovery.

CASE 15.—R. O. CROISER; private. Age 38. Punctured wound of foot.

Period of incubation, 6 days; stiffness of jaw and neck; general convulsions second day; treatment began first day; continued 2 days. N. Y. S. D. of H.'s antitoxin used. Subcutaneous injection of antitoxic serum, 4 injections, 10 c.c. each. Intraneural injection, 10 c.c. Total amount injected, 50 c.c. Death on third day.

CASE 16.—W. J. CARR; private. Age 10. Pistol shot wound index finger. Period of incubation, 5 days; general convulsions first day; treatment began on first day; continued 1 day. N. Y. S. D. of H.'s antitoxin used. Intraneural injection, 8 c.c. Intravenous injection, 40 c.c. Total amount injected, 48 c.c. Death on second day.

CASE OF TETANUS TREATED BY INTRACEREBRAL INJECTION OF
ANTITOXIN MADE AND FURNISHED BY THE NEW YORK STATE
DEPARTMENT OF HEALTH.

CASE 1.—H. W. NASH; private. Boy. Cartridge wound of hand. Period of incubation, 7 days; general convulsions 7 hours, very severe; treatment began second day; continued, 2 injections. N. Y. S. D. of H.'s antitoxin used. Intracerebral injection of antitoxin administered daily, 2 injections 5 c.c. each. Total amount injected, 10 c.c. Death in convulsion, second day.

THE TREATMENT OF TETANUS BY MAGNESIUM SULPHATE.

BY JOSEPH A. BLAKE, M.D.,

OF NEW YORK.

THE treatment of tetanus by magnesium sulphate was suggested by the discovery, by Dr. S. J. Meltzer, of the marked action of this salt, when applied to nerve-tissues, in inhibiting both afferent and efferent impulses.

Although similar effects can be produced by subcutaneous or intravenous injections, they are accompanied by symptoms due to the depressing effect of the drug upon the higher centers, both in the medulla and cerebrum. The action on the medulla produces slowing of respiration and finally death by paralysis of the respiratory center.

In lumbar injections into the subdural space, the drug acts directly upon the nerve-trunks at the site of injection, as is evidenced by paralysis of motion and sensation in the lower extremities, and as it diffuses itself upward along the cord, the paralysis extends to the trunk and upper extremities, diminishing, however, in intensity as it progresses.

Absorption of magnesium sulphate from the spinal canal is fairly slow, and definite action upon the nerve-trunks may be obtained while the general effects upon the higher centers may not manifest themselves for several hours or may be wholly absent. In fact, Meltzer has found that the magnesium sulphate may be removed from the spinal canal by puncture and washing, after the desired local effects have been obtained, and the undesirable action upon the higher centers wholly prevented or stopped, if already commenced. On the other hand it has been demonstrated by Dr. Teague, in experiments carried out in the Surgical Research Laboratory of Columbia University, that the drug is, to a certain extent, cumulative in its action.

* Read before the American Surgical Association, Cleveland, Ohio, June 1, 1906.

For instance, a dose insufficient in itself to produce symptoms when injected into the peritoneal cavity of guinea-pigs, will produce death when repeated at the end of twenty-four hours. In the treatment of tetanus, the dose is ordinarily repeated and this fact should be borne in mind.

Meltzer found that one cubic centimeter of a 25 per cent. solution of magnesium sulphate to every twenty-five pounds bodyweight was sufficient, when injected into the spinal canal, to produce in most cases anæsthesia to the surgical degree from the neck down. As reported in a former paper,¹ I have found a marked variation in the effects of the drug,—for instance, a similar amount per pound of bodyweight produced no anæsthesia and very slight motor-paralysis in one patient, while in another its action was most profound, producing unconsciousness which lasted nineteen hours and paralysis of motion and sensation persisting for over forty-five hours. Age and sex seem to have a direct bearing upon its action and in the same paper I made the following statement: “As far as can be learned from our present experience, children are quite susceptible, and women more so than men. The dose for a child should probably never exceed one cubic centimeter for every twenty-five pounds bodyweight, the dose for a woman should not be less, while the dose for a male adult should probably not be less than a cubic centimeter for every twenty pounds.” In the treatment of tetanus, the dose usually has to be repeated and consequently may be corrected, so the uncertainty in regard to its effect is not so important as it otherwise might be. While uncertainty as to its effects might contraindicate its use for the less dangerous conditions, tetanus is attended by such a great mortality that we are justified in using anything that promises to be beneficial.

It is unfortunate that we are unable to derive much information from experimental work with animals, since the anatomical peculiarities preclude intraspinal injections except in monkeys. Dr. Teague has found that intraperitoneal injec-

¹ Jour. Surg., Gyn. and Obstetrics, May, 1906.

tions in guinea-pigs produce little or no effect on the convulsions in induced tetanus unless a lethal dose is given. For instance, if a local tetanic spasm of a limb is induced by the injection of tetanus toxine, it cannot be controlled by an intraperitoneal injection of magnesium sulphate unless in excessive doses.

From our experience in human tetanus, we know that intraspinal injections relieve spasm, so that we must infer that it produces a block of nerve-impulses by direct action on the nerve-trunks. So far, its employment in human tetanus has not been attended by uniform results. This fact may be due to different degrees of susceptibility on the part of the patient and partly by variations in technique or lack of experience in the use of magnesium sulphate on the part of the medical attendant. As far as I can ascertain, only four cases of tetanus have been treated with magnesium sulphate. The first was treated by myself at the Roosevelt Hospital and this together with a case treated by Dr. F. H. Markoe at the New York Hospital, are reported in full by me in the *Journal of Surgery, Gynecology, and Obstetrics* for May, 1906. Since then, the report of two other cases by Dr. Samuel Logan, of New Orleans, has appeared in the *Journal of the American Medical Association* for May 19, 1906. In addition to these four cases of tetanus, a case of miliary tuberculosis, with symptoms closely resembling those of tetanus, has been treated by me and is interesting in demonstrating the effect of the drug upon the convulsions. Of these patients, only one has recovered, namely, the first patient treated by myself.

A detailed report of these cases in the present paper would require too much time, and I consequently limit myself to a statement of my deductions derived from the study of them. In my patient, a case of acute tetanus in a boy fifteen years of age, starting in a wound of the hand, we were either very fortunate in hitting upon the correct dose or else the patient was peculiarly susceptible to the action of the drug. There is not the slightest doubt in my own mind, or in the minds of those who observed the patient, that the drug had a very

marked effect in inhibiting the convulsive seizures, relieving pain and producing rest. For instance, the patient at the beginning of the treatment was in a condition of practically constant opisthotonos, with rigid scaphoid abdomen and well-marked trismus. Rest and nutrition were impossible. The effect of magnesium sulphate was to produce complete relaxation of the muscles of the trunk and the extremities and considerable relaxation of the muscles of the jaw, so much so that the patient rested quietly and could swallow easily.

The injections controlled the convulsions in this patient for periods varying from twenty-nine to thirty-seven hours each. At the latter part of these periods the convulsions would begin to return and gradually increase in severity until they reached a point when it was deemed wise to give another injection. No injurious effects were noted in this patient except that throughout the treatment there was, as might be expected, paralysis of the bladder. The dose was the same as recommended by Dr. Meltzer for the production of anæsthesia. At the time the injections of magnesium sulphate were stopped, the patient was running along with the symptoms we would expect in an ordinary case of chronic tetanus. At one time, six days after the last injection of magnesium sulphate, the convulsions became more severe and magnesium sulphate was given again with similar effect. Before commencing treatment with magnesium sulphate in this patient, he was given several injections of tetanus antitoxine, one of them into the cervical cord with no apparent effect.

My impressions from observing this patient were that with the aid of magnesium sulphate we were able to keep up nourishment and strength, so that his vital forces could control the disease, and that in reaching this control the injected antitoxine was probably a great aid. According to Norris, death in tetanus may occur in a convulsion and be due to asphyxia or spasm of the heart, or, on the other hand, in about half the cases it is due to exhaustion. Exhaustion may be caused by excessive convulsions and by lack of nourishment. In such cases, judging by our experience in the case just reported,

magnesium sulphate will be a great help. There are, however, a certain number of cases of tetanus which die in the first few days of the disease and which die in a condition of asthenia which can hardly be attributed to exhaustion from convulsions or from lack of nourishment. In these cases death seems to be due to a depressing action of the toxins, and magnesium sulphate would probably be of no benefit. Dr. Markoe's case is an example of this class. In this case a moderate dose of magnesium sulphate was given fifteen hours after the initial symptoms of the disease, with only a slight effect upon the convulsions, the patient dying thirteen hours later, the entire illness lasting twenty-eight hours. There were no symptoms referable to an overdose of magnesium sulphate.

In Case I, reported by Dr. Logan, death occurred at the end of the fourth day of the disease with symptoms of heart failure and hyperpyrexia. Two injections of magnesium sulphate were given. The first, about forty-one hours before death, produced complete relaxation even of the jaws, and relieved the pain completely for over twelve hours. The tonic spasm then returned rapidly in the trunk and extremities. Eighteen hours after the injection the general spasm was marked and there was twitching on attempting to swallow. The second injection was given twenty-four hours after the first and again produced complete relaxation, which lasted until his death, sixteen hours later, with the exception of a general convulsion induced by giving an enema two hours after the last injection of magnesium sulphate.

This patient's condition although somewhat improved by the first injection, grew progressively worse after the second. There was excessive bronchorrhea, the respirations were rapid and shallow, the heart's action feeble. The respiration was not slowed as is usually the case with large doses of magnesium sulphate.

An analysis of the treatment in this case is noteworthy. The patient was a boy eleven years of age: the bodyweight was estimated at eighty pounds. On the first day of the disease he was given fifty cubic centimeters of antitetanic serum

by lumbar puncture. In the thirty-six hours preceding the injection of magnesium sulphate he had received 170 grains of chloral and 450 grains of bromide without effect upon the convulsions. Both injections of magnesium sulphate were given under general anæsthesia. Fifty cubic centimeters of antitetanic serum were given at the same time with the first injection. The duration of the first anæsthesia was forty minutes, of the second, thirty-five. Possibly the large doses of chloral may have depressed the heart's action and that together with the ether may have caused the bronchorrhea. It is not necessary to give an anæsthetic to perform lumbar puncture, and one of the advantages of magnesium sulphate is that it produces sufficient anæsthesia for redressment of the wound. The dose of magnesium sulphate was large, one cubic centimeter of the 25 per cent. solution for every twenty pounds at the first dose, and one cubic centimeter for every twenty-four pounds bodyweight at the second dose. Possibly its action may have been cumulative, inasmuch as the dose was repeated in twenty-four hours. The action of the second dose was, certainly, very profound.

In the second case reported by Dr. Logan there was absolutely no result from the use of magnesium sulphate. The patient was a woman, twenty-four years of age, and received a dosage corresponding to one cubic centimeter for every twenty-five pounds bodyweight. The first injection producing no result, it was followed, seventeen hours later, by another, the patient dying of failure of respiration in a tetanic seizure a short time afterward. Although this last was a severe case, there should have been some result, and the failure of the magnesium sulphate is apparently another instance of the unreliability that has been demonstrated in its use for producing anæsthesia.

In the case of general miliary tuberculosis resembling tetanus already mentioned, magnesium sulphate was quite efficient in controlling the convulsions and was repeated nine times in eight days, once with an interval of only thirteen hours, without producing untoward symptoms.

My impression of the drug is that although we cannot be certain of its effect, yet it is reasonably safe and offers us a means of modifying the convulsions and relieving pain in a way no other drug has approached. For these reasons alone it is worthy of a more extended trial. It is not a specific treatment, but it produces anæsthesia, which may be taken advantage of for intraneural or other injections of tetanus antitoxine and for revising the site of the infection.

EARLY OPERATION IN TRAUMATIC INTRACRANIAL HÆMORRHAGE.*

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THE extreme gravity of hæmorrhage of the intracranial vessels is universally recognized, and the necessity of early interference as affording the only relief to this condition is generally accepted by surgeons, yet there are still a number of cases allowed to die from want of operation. The object of this paper therefore, is to suggest a more frequent resort to exploration of the skull in the hope of thereby saving cases which otherwise would result fatally. While no doubt recovery is possible under expectant treatment, it is equally true that many more die from want of operation, and some observers state that over ninety per cent. die under expectant treatment. Not infrequently one reads in the medical journals reports of cases which could have been saved by operation, and it is the experience of surgeons connected with the large hospitals to observe at times autopsies which reveal the fact that early resort to trephining would have been followed by success.

The failure on the part of the surgeon to operate in these cases may be ascribed to several reasons. It may be due to the extreme difficulty, or impossibility, of arriving at a diagnosis; and it must be conceded that very often from the absence of a history of the injury or from the presence of existing complications, a positive diagnosis cannot be made, and accordingly expectant treatment is indicated. It must be said, however, that inquiry into the history of a case previous to having been seen by the surgeon is at times incomplete and that a more thorough investigation reveals a history

* Read before the New York Surgical Society, April 25, 1906.

of trauma sufficient to justify exploration. In other cases, from the history of the injury and from the fact that symptoms of severe compression followed an apparently slight degree of trauma, the surgeon suspects or diagnoses severe contusion or laceration of the brain, and accordingly considers operation useless. The diagnosis of cerebral contusion or laceration, and especially its extent, is more or less conjectural, unless the nature of the injury is such as to allow inspection of the brain. And it is from the opinion so often expressed by surgical writers that subdural hæmorrhage is usually accompanied by cerebral contusion, that an expectant attitude is advised in this variety of intracranial hæmorrhage. It is a fact, however, that operation (or autopsy) has shown that cerebral contusion is by no means so frequent as is supposed, and in many instances death was solely due to compression of the brain by the blood-clot. Some authorities also do not consider the presence of contusion accompanying hæmorrhage as contraindicating operation, and in the opinion of others the removal of the blood-clot has a beneficial effect upon the complicating contusion of the brain.

The absence of focal symptoms, even when the symptoms of general and increasing cerebral compression are present, is considered by some surgeons sufficient reason for desisting from operation, as information is lacking as to where the trephine should be applied. Perhaps this may apply in a few cases, but in the great majority of cases where there is a definite history of trauma, a careful examination of the scalp will reveal a contusion or abrasion which will supply the desired guide.

Another cause which bears on the question of diagnosis (and this applies mostly to the general practitioner) is the indefinite and confused idea which prevails concerning the condition known as cerebral concussion. In the average surgical text-book one reads that there may be a light degree or a severe degree of concussion and, consequently, the patient lies unconscious for a period varying from a few moments to several days. Again, we read, if the symptoms last for days,

then the diagnosis of concussion must be excluded, and some severe intracranial injury is to be suspected. If it were remembered that the symptoms of pure cerebral concussion are transient in character and that many so-called cases of severe concussion are in reality cases of compression, it would result in an earlier recognition of the condition, which at times demands early interference, and the cases would accordingly reach the surgeon while there was still a chance for relief. While perhaps a more careful inquiry into the history of trauma might lessen the difficulty of diagnosis, it would seem that the suspicion of existing cerebral contusion and also the absence of focal symptoms are not sufficiently valid reasons for desisting from operation.

Hæmorrhage may follow injuries of the various intracranial vessels, but the one most frequently involved is the middle meningeal artery, next the vessels of the pia, and finally the venous sinuses of the dura. The extent of the hæmorrhage, as well as the rapidity of its formation, depends upon the size of the injured vessels, and the result of the hæmorrhage is a diminution of the space in the cranial cavity and a corresponding degree of cerebral compression. Hæmorrhage from the trunk or a large branch of the middle meningeal artery is followed by the formation of a steadily-increasing clot which finally interferes with the entire cerebral circulation, and death follows. Should, however, the clot not be large enough to cause a high degree of intracranial tension, but of sufficient size to cause persistent pressure, it is equally dangerous, as the continued pressure causes œdema of the brain and thus adds to the increasing compression.

The symptoms of traumatic intracranial hæmorrhage are those of cerebral compression, and the main indication of treatment is the removal of the clot causing the pressure on the brain; at the same time ligation of any blood-vessels exposed by the operation.

Intracranial hæmorrhage is divided into the extradural and subdural varieties, according to the location of the clot regarding the dura, and it may be of interest to consider some

points in regard to these varieties of hæmorrhage, and in addition to report the history of some cases.

I. *Extradural Hæmorrhage*.—This variety of hæmorrhage is caused most frequently by rupture of the middle meningeal artery, less frequently by injury of the pial vessels, and occasionally by an injury of the venous sinus. Rupture of the middle meningeal artery generally occurs in connection with the fracture of the vault or base of the skull and in the majority the violence is produced by a blunt object. Should the fracture be a comminuted one, the artery may be injured by a splinter of bone or cut by the edge of a fragment. In the case of a simple fissure crossing the course of the artery, the vessels may be cut by the sharp edge of the bone which is depressed at the time of fracture; or the vessel lying in a groove is ruptured at the time the bone is fractured. The artery, owing to its greater want of elasticity, may however be ruptured without any accompanying fracture of the skull.

Of infrequent occurrence, but of importance as regards diagnosis, is the fact that the artery may be ruptured on the side of the skull opposite to that on which the violence was inflicted.

The clinical picture of rupture of the middle meningeal artery varies accordingly as the hæmorrhage takes place externally or is confined between the dura and the bone. When occurring with compound comminuted fracture, the blood may escape externally between the fragments, and the symptoms then are those of free hæmorrhage. More frequently, however, the blood from the injured vessel extravasates between the skull and the dura, detaching the latter from the bone and forming a hæmatoma, usually of good size, which exerts pressure on the underlying brain.

The symptoms of rupture of the middle meningeal artery are those indicative of general intracranial pressure, such as disturbances of consciousness, changes in the pulse and respiration, and combined with these general symptoms are those indicating local pressure of the motor area with which the artery is so closely related. The arm centre of the motor area

is the one most commonly affected, but not infrequently there may be complete hemiplegia of the opposite side of the body.

An important symptom, and by some considered as characteristic of rupture of this artery, is the so-called free or lucid interval: the interval of consciousness which precedes the signs of compression. The interval may or may not be preceded by loss of consciousness due to the shock of the injury. While its duration varies, it generally lasts but a few hours—possibly a day—and in extremely rare cases three or four days.

When the blood escapes externally, the diagnosis of rupture of the artery is easy, but in intracranial hæmorrhage it is more difficult, and to operate successfully, one must not only determine the presence of the hæmorrhage, but locate its site, if possible. As given in the text-books, the principal symptoms upon which a diagnosis may be based are the lucid interval, especially if it be of short duration, the hard, slow pulse (so-called pressure pulse), stertorous respiration, together with the signs of gradually-increasing hemiplegia. If, in addition to these, there are present at the point of injury a fracture, a contusion, or even an abrasion of the scalp, then the diagnosis is certain. Such a combination of distinct and characteristic symptoms, however, is unusual, and often the clinical picture is incomplete or complicated with symptoms of accompanying brain injuries.

As an example of the difficulties in arriving at a positive diagnosis, is the history of the following case:

CASE I.—W. N., 45 years of age, admitted to the New York Hospital on August 24, 1902, at 10.30 P.M.

History.—While slightly intoxicated, fell down stairs, striking on the back of his head. He was picked up somewhat unconscious and brought by ambulance to the hospital. The accident occurred half an hour previous to admission. On admission the patient was deeply unconscious; there was no reaction to irritation such as supraorbital pressure; loss of corneal reflex, pronounced exophthalmos, right pupil somewhat dilated, left pupil contracted,

full stertorous respiration (20 per minute), a bounding pulse much above normal, rate 110; no fascial or other paralysis could be determined; knee-jerk slightly increased; no ankle clonus. Careful examination of the scalp revealed a spot of œdema about the size of a dollar behind and above the right ear. The patient rapidly grew comatose, the exophthalmos increased, both pupils dilated, pulse grew more rapid and irregular, and death followed about three hours after admission.

Autopsy.—Save for a slight hepatic cirrhosis the viscera were healthy. Cranium: above and behind the right ear an ecchymotic spot, beneath which was an oblique fissured fracture about $1\frac{1}{2}$ inches long. On opening the skull, the cranial cavity on the right side was found occupied by an extradural hæmorrhage extending from the groove of the anterior branch of the middle meningeal artery backward over the occipital region, the clot measuring six inches by three inches, and one and three-quarters of an inch in thickness. The posterior branch of the middle meningeal was completely ruptured at a point directly beneath the fracture. The brain was distorted by compression of the clot, the ventricles almost completely collapsed. Otherwise the brain was entirely normal.

This case was diagnosed by the ambulance surgeon as one of alcoholism, and the patient was admitted to the medical wards, but the house physician recognized it as a case of cerebral compression. Owing to the pronounced exophthalmos, and from the fact that severe symptoms of compression followed quickly after a slight degree of tremor, he suspected that some grave intracranial lesion was present, most likely a severe laceration or contusion of the brain, and operation was considered useless. Autopsy, however, revealed the fact that the brain was uninjured and the sole cause of death was due completely to the hæmorrhage. This case is a good illustration of the fact that the diagnosis of cerebral contusion is more or less conjectural, and the autopsy revealed a condition of affairs which could have been met successfully by an explorative operation. The indications for operation were well marked, in that there was a history of trauma, a localized

contusion of the scalp at the site of violence, and the symptoms of a rapid and steady increase of intracranial pressure.

In addition to this case, the history of another which came lately under my care, may be of interest.

CASE II.—J. K., 25 years of age, messenger boy, was admitted to the New York Hospital on March 1, 1906, at 3 o'clock, A.M.

History.—Fifteen hours previous to admission the patient was thrown from a wagon to the pavement, striking on the back of the head. He was not rendered unconscious, but simply a little dazed, got up at once and went about his work for the rest of the afternoon. In the evening he complained of headache, which steadily increased so that he could not sleep, and he applied for admission to obtain relief from the pain.

Admission.—Over the external occipital protuberance there is a small, shallow scalp-wound, and on enlarging it, it was found to not involve the pericardium. No bony irregularity or depression could be felt. Pupils equal and react normally; reflexes normal; no sensory disturbances or motor paralysis. Pulse 84, temperature 100, respiration normal. General condition good. Patient is rather pale in appearance, and complains bitterly of occipital headache. Antiseptic dressing applied to the wound, and hypnotics ordered. On the following day the patient's condition remained practically the same, except that a slight degree of opisthotonos was noted. During the following night there was a free hæmorrhage from the scalp wound, which somewhat relieved the headache. On March 3 the opisthotonos was well marked. No paralysis or sensory disturbances were observed; the chief complaint was still the severe headache. The pulse was somewhat diminished in frequency, rather irregular in force, and the sphygmomanometer showed a decided increase in arterial pressure. The blood-pressure at 10.30 A.M. was 190 mm.; 2.30, 214 mm., and at 7.40 P.M. 240 mm. In the evening examination of the right fundus showed the presence of a choked disk. During the night the wound again bled rather freely, and the patient slept at intervals. On March 4 the patient was quieter, complained less of headache and appeared to be more comfortable. It was noticed, however, that he was rather dull and apathetic. The

blood-pressure at 9.40 was 206, at 12.40, 208, and at 3.45, 212 mm. In the afternoon the pulse was more irregular in force and frequency than at any time before. At 6.40 P.M. the patient suddenly became unconscious and stopped breathing. Artificial respiration was resorted to and practiced for about six-and-a-half hours. During this time the patient made no effort to breathe. Spinal puncture taken at this time showed a clear fluid under no tension. The pulse became slower and weaker and finally very irregular. Some slight twitching movements were noticed on the right side of the face shortly before death, which occurred at 1.30 A.M. on March 5th.

Autopsy.—Nothing abnormal about viscera. Head: a small wound in the median line just back of the occipito-parietal suture. The scalp of the entire occipital region is infiltrated with blood; skull-cap thin, mesocephalic. Dura thin, non-adherent, but abnormally tense. Tension uniform on both sides. Internal surface smooth and glistening. A small amount of blood is found beneath the dura on the right. Occipital meninges on the right side are infiltrated with blood; convolutions of convexity markedly flattened. Base of brain shows a slight contusion on the under surface of the right frontal lobe and on the anterior surfaces of the temporo-sphenoidal lobes. Basal vessels normal. Right occipital lobe posteriorly and the posterior portion of the right lobe of cerebellum are markedly flattened. Base of skull: a large epidural blood-clot is situated in the posterior fossa on the right side extending up to the occipito-parietal suture, but not beyond the median line. This clot occupies an area about the size of the palm of the hand, and at its thickest portion measures about $1\frac{1}{4}$ cm. Corresponding to this clot there is a fracture extending from the right occipito-parietal suture near the median line downward and backward into the posterior fossa and terminating 2 cm. to the right of the foramen magnum. Aside from the slight contusions previously noted the brain is normal.

This case contains many points of interest, one of which is a lucid interval lasting four days. Usually the duration of the interval in extradural hæmorrhage is limited to a few hours, and it is extremely rare to find an interval lasting as long as it did in this case. Its explanation may be due to the

location of the fissured fracture in a region where the branches of the artery are of small size, and the hæmorrhage was thus a gradual one. The relief afforded to the patient by the bleeding from his wound, however, is very significant, and most probably the intracranial pressure was thus lessened, lengthening thereby the duration of the lucid interval.

The most prominent subjective symptom was the severe headache which was mainly confined to the occipital region and marked by frequent exacerbations of pain, so that the patient would cry out. This was particularly noticeable on the second and third days following the injury; on the fourth day the headache had diminished and the patient expressed himself as feeling comfortable. The sudden paralysis of the respiratory centre without previous disturbance of consciousness is very unusual, as the order of succession of the centres affected is the reverse of what we have been taught. Generally the cortex is the centre first affected by pressure, and the pons and the medulla are the last. During the four days the patient was under observation, there was nothing abnormal about the respiration both as to rate and character, and the paralysis of the respiratory centre was sudden and not preceded by cyanosis. The pulse was never very slow, the lowest being 54 in the afternoon of the third day, when there was some irregularity in tension. On the morning of the following day the irregularity had increased, but the tension was lower. The presence of disturbances of sensibility, such as contralateral anæsthesia or hyperæsthesia is mentioned by some observers as indicating hæmorrhage from the posterior branch of the middle meningeal artery, but in this case of posterior hæmatoma these symptoms were absent.

As to the diagnosis of the case the positive determination of hæmorrhage was never possible, but in the afternoon of the fourth day, some four hours before the sudden paralysis of the respiratory centre, I suspected that there was hæmorrhage and decided to explore the skull, but before doing so requested the house surgeon to have a neurologist examine the patient and obtain his opinion. My reasons for exploration were the

history of trauma, diminution of the headache, the fact that the man seemed rather dull, and finally the presence of a choked disk. In addition, the increase in irregularity of the pulse, together with its increased tension, added to my suspicions. The neurologist did not see the patient until two hours after the onset of respiratory paralysis, and the time of his visit was during the period of artificial respiration. From the history of the case and the sudden cessation of breathing he diagnosed a hæmorrhage into the fourth ventricle. The result of the autopsy revealed a condition of affairs which in all probability could have been satisfactorily treated by operation, and the fatal ending was due to cerebral compression from hæmorrhage.

In reviewing the history of the case while under observation, it will be recognized that there was a well-marked and increasing cerebral compression in the presence of choked disk, and an increase in blood-pressure as shown by the sphygmomanometer, but with these symptoms there was no interference with consciousness and the rational condition of the patient up to the time of the respiratory failure rather misled me. The case shows that well-marked cerebral compression is possible without interference with consciousness.

The value of the presence of a choked disk, as indicating compression, as well as the assistance of the sphygmomanometer to ascertain the degree of blood-pressure, is well illustrated in the present case; and in several later cases I have always relied upon the examination of the fundus and the use of the sphygmomanometer in determining the presence and degree of cerebral compression. The postponement of operation until the neurologist's opinion could be obtained resulted in the loss of a favorable opportunity.

An occasional cause of extradural hæmorrhage is a wound of one of the venous sinuses of the dura, and of these the superior longitudinal and the lateral sinus are the ones most frequently injured, and they are also those most easily reached by the surgeon. As a rule the injury is associated with fracture of the skull and is due to perforation by a bony splinter

or from the sharp edge of a fragment of bone. In other cases the sinus may lie in the path of some foreign body penetrating the skull from without, such as a bullet; or during an operation the sinus may accidentally be wounded by a chisel or a trephine. Owing to their want of elasticity and from their firm attachment to the skull the walls of the sinus do not collapse when wounded, and accordingly it increases the free disposition to hæmorrhage and diminishes the chances of a spontaneous arrest of the same.

As regards the diagnosis, the nature of the injury may be suspected when there is a free venous hæmorrhage of the wound located over the course of the sinus; should there be no chance for escape of the blood, it extravasates between the skull and dura, producing symptoms of increasing cerebral compression. The symptoms of compression, however, come on slowly, owing to the low blood-pressure in the sinus, and focal symptoms are usually absent. When associated with simple comminuted fracture, the blood may also extravasate between the skull and pericranium, forming a hæmatoma of increasing size, as the following case well illustrates:

CASE III.—A girl, 11 years of age, fell through a skylight, striking on her head on the floor below, a distance of some ten feet. She was stunned for a few moments, and on coming to, noticed that her nose was bleeding. A physician was called and on examination found nothing beyond a contusion of the forehead. During the following two days there was frontal headache and a swelling of the forehead gradually increasing in size. On the third day, as she was rather morose and apathetic, her parents brought her to the Out-patient Department of the New York Hospital. Over the median line of the frontal region, just at the edge of the hair, there was observed a semi-fluctuating swelling about the size of a hen's egg. An incision into it was made by the examining surgeon, and after evacuating a good-sized hæmatoma under the pericranium, a depressed fracture of the underlying bone was discovered. The wound was packed with sterile gauze and the patient sent into the hospital for operation. On admission the girl seemed rather dull and inclined to sleep, but

would respond to questions. There were no motor or sensory symptoms. Pulse 88, temperature 100, respiration 22. On the following day, under ether, the fracture was exposed through a crucial incision. It was found to be a comminuted depressed fracture of the frontal bone, situated a little anterior to the junction of the sagittal and coronal sutures. There was a circular area of depression about one-and-a-half inches in diameter and almost a half inch in depth at the centre, from which the separate fractures ran out radially. The depressed bone was composed of five fragments, and from the lower end of the depression, a little to the right and parallel with the median line, was a fissured fracture running toward the base of the skull. With an elevator one of these depressed fragments was removed and a very profuse venous hæmorrhage set in from beneath the edge of an adjoining fragment. Quickly removing the latter, it was seen that the hæmorrhage came from a hole about one-eighth of an inch in diameter in the wall of the superior longitudinal sinus. The bleeding was controlled by pressure with the tip of the left index-finger, while the remaining fragments and a large extradural blood-clot were removed. The clot, about two inches in diameter and extending both sides of the median line, was removed by means of pledgets of gauze, combined with gentle irrigation. A sterile gauze compress, half an inch square and made up of several thicknesses, was then substituted for the finger over the sinus wound, and over the compress was packed a short strip of inch-sterile-gauze. The wound was partially closed by suture and a firm sterile dressing applied. On recovery from the anæsthetic the child was placed in an upright position in bed. The postoperative history was uneventful. Three days after operation the strip of gauze packing was removed; on the fifth day the compress over the sinus was removed. There was no recurrence of hæmorrhage, and the wound was rapidly covered with healthy granulations. On the tenth day it was noticed that whenever the child coughed, or blew her nose, small quantities of pus appeared at the lower part of the wound. On inserting a probe, it passed into a sinus leading downward for two-and-a-half inches, but no bare bone could be detected. The suppurating sinus was drained with gauze, and in no way interfered with the rapid healing of the wound. The effect of the operation on the child's disposition was quite marked,

in that her previous moroseness and apathy were followed by brightness and activity. Six weeks after the operation she was discharged with the wound healed and no symptoms of any serious effect of the injury upon the brain.

In this case the sinus was wounded by a sharp edge of one of the depressed fragments, probably the second one, as the location of the wound of the sinus corresponded exactly with the centre of the depressed area, where the edges of the fragments were sharply pointed. The absence of a scalp-wound is to be noted, as it is rather rare, since compound fractures of the skull usually accompany wounds of the superior longitudinal sinus. This accounts for the extravasation of blood between the pericranium and the skull and the gradually increasing swelling in the frontal region. Although a good-sized extradural clot existed, it was from the ability of the blood to extravasate outside of the skull that the intracranial pressure was not increased sufficiently to cause definite symptoms of cerebral compression. The main reason for seeking advice at the hospital was the gradual increase in the size of the swelling at the forehead, together with the change in the child's disposition. The physician in charge of the case previous to admission made a diagnosis of concussion and prescribed nerve tonics. This is merely mentioned as an example of the mistaken ideas which many general practitioners entertain concerning the question of cerebral concussion.

An interesting feature is the ease with which the hæmorrhage at the time of operation was controlled. The opening in the wall of the vessel was large enough to allow of serious hæmorrhage and until controlled by the finger it was most profuse, but with the finger during operation, and the gauze packing subsequently, the complication was readily met. As a rule, pressure is sufficient to control the bleeding from an ordinary wound of the sinus, but should it be necessary to cut through the vessel in the course of an operation, then ligation is necessary. Suture of the wound of the vessel and the application of arterial clamps have been successfully used, but in

my opinion—unless the wound be a very large one—gauze packing will do as well and is a much simpler method. It has the disadvantage of leaving an open wound, thus increasing the chances of infection, but with ordinary antiseptic precautions this danger is very small.

The appearance of pus on the tenth day at the lower edge of the wound after the girl had coughed or blown her nose, led us to suspect that the infection was due to the fissured fracture extending either into the frontal sinus or nasal cavity. This suspicion was strengthened by the discovery with the probe of a narrow sinus leading down to the base of the skull. It should be remembered also that there was epistaxis following directly after the fall. Fortunately, infection did not interfere with the wound healing, and the danger of a suppurative phlebitis was lessened by the presence of healthy granulation covering the wound of the sinus. As the dura at operation was found uninjured, and there were no symptoms at any time indicating brain injury, it is most likely that the results of the fall were limited to a fracture of the frontal bone and a wound of the underlying superior longitudinal sinus; and probably the future prognosis of the case is good.

II. *Subdural Hæmorrhage*.—Subdural hæmorrhage most frequently follows injuries of the vessels of the pia mater, less frequently a rupture of the middle meningeal artery, and occasionally an injury of a venous sinus.

When the blood extravasates into the subdural space, the anatomical conditions are more favorable for the formation of a diffuse hæmatoma, but frequently at operation the clot is found to be circumscribed, resembling the form characteristic of extradural hæmorrhage.

The etiology of subdural hæmorrhage corresponds entirely with that of extradural hæmorrhage. The symptoms are those of cerebral compression, and its clinical picture resembles so closely that of extradural hæmorrhage that, as a rule, a differential diagnosis is impossible. The lucid interval which has been emphasized by many observers as a characteristic symptom of rupture of the middle meningeal artery is also characteristic of subdural hæmorrhage.

In Vol. 59 of Guy's Hospital Reports, Bowen reports seventy-two cases of traumatic subdural hæmorrhage collected from American and British sources which he has systematically studied. These cases have been divided into Class A and Class B, the former being cases of pure compression by blood-clots and not attended with contusion or laceration of the brain, the latter (B) in which compression has been complicated by the presence of lacerations and severe contusions, which were the cause of death. In sixty of the seventy-two cases there was an interval of consciousness previous to the appearance of the symptoms of compression. Bowen considers the period of lucidity which has hitherto been emphasized in relation to extradural hæmorrhage, as of equal importance in subdural hæmorrhage.

As regards the duration of the free interval, one is impressed when reading this article with the long period which may elapse before signs of compression appear. In the greater number of instances it was over twenty-four hours, and the longest interval was twenty-seven days. The duration of the free interval is, therefore, an important point in differentiation, and should the interval be one of days, instead of hours, it indicates subdural hæmorrhage. Should, however, the lucid interval be absent, a differential diagnosis is impossible.

The course of subdural hæmorrhage is generally more protracted. Cases are reported where patients, who had been unconscious for weeks, gradually regained consciousness and made a good recovery. On the other hand, very rapidly developing cases have been observed.

The compression symptoms may be general or local, and in the presence of the latter operative interference is indicated. Should, however, the general symptoms show an increase of intracranial pressure, operation is also indicated. But it is in cases where the general symptoms are those indicating a stationary condition of pressure and where focal symptoms are absent, that the surgeon may be in doubt whether to operate. It must be remembered, however, that in these cases of protracted coma, interference should not be postponed too long,

as the persistency of pressure is equally dangerous, since it favors œdema of the brain and thus increases compression. Should the patient recover without operation, cortical atrophy may result, together with degeneration of the lateral columns of the spinal cord.

The following case is an example of the difficulties which may confront the surgeon in arriving at a decision to operate:

CASE IV.—K., 21 years of age, bartender, admitted to the medical side of the New York Hospital in the morning of April 14, 1903. He was said to have fallen in a fit thirty-six hours previous to admission, and had remained unconscious ever since. On admission the patient was unconscious, but roused to resist irritation. There was an œdematous swelling of the scalp about one inch in diameter over the right parietal eminence. No signs of depressed bone. Slight subconjunctival ecchymosis of the inner canthus of the right eye. The pupils were normal and reacted. Respiration 20, pulse 72, temperature 100. No symptoms of anæsthesia or motor paralysis; neck rigid and slightly tender; knee-jerk exaggerated; spasticity of legs; plantar reflex normal, no ankle clonus; heart and lungs normal; abdomen retracted; leucocytes 11,600; urine sp.g. 1028; no sugar or albumen, few hyaline casts; blood-pressure 170 mm. Spinal puncture, no increase in spinal pressure. Spinal fluid diffusely blood-tinged and on microscopic examination showed a few blood-cells, a few leucocytes, no organisms. In the evening temperature was 101.6, pulse 84. April 15, patient very restless all night; still unconscious. Temperature 102.4, pulse 84, blood pressure 182 mm. There is definite, but not absolute loss of power in the left lower extremity; no paralysis of face or left arm. Patient sent to the operating-room.

Operation.—Large horseshoe flap, turned down from right parietal region, exposed a fissured fracture of the skull which could be traced forward to the orbital margin and backward to be lost in the occipital bone. At a point located approximately over the upper part of the right motor-area, there was a slight depression of the lower edge of the fracture. Trephine was applied at this point, and a button of bone about one inch in diameter removed. No comminution of the inner table was found—no epidural clot;

the dura rather dark-colored, tense and not pulsating, bulged into the trephined opening. With rongeur forceps the opening was increased to about two inches in diameter. The dura was opened through a crucial incision and a good-sized clot exposed. This was gently removed, and some dark, bloody serum, containing lacerated brain tissue, followed. After carefully sponging the cortex, there was seen a cavity extending into the brain about half an inch and large enough to admit the tip of the index-finger. The brain still bulged into the wound and prevented complete suture of dura. The scalp wound was sutured with silkworm gut up to its convexity, where a small rubber tissue drain was inserted. Mild stimulation was necessary after operation. On April 16th and 17th patient remained unconscious and there was a free discharge of bloody serum from the wound, necessitating frequent changes of dressing. On April 18th patient answered questions, but was dull. On April 19th full consciousness was regained and patient said he had been struck with a sand-club during a fight. On April 25th sutures were removed from the convexity of the wound, and on slightly retracting the flap a small hernia of the brain was discovered. On May 10th hernia had principally disappeared, and on May 22d wound was entirely healed. On June 2d patient was discharged cured. In the following autumn he had epileptic seizures, rather mild in character and at intervals of two weeks. Under the use of bromides they have disappeared, and he has had but one seizure during the past year.

In this case the history of trauma was purposely concealed and, accordingly, the patient was admitted to the medical wards of the hospital. Careful examination having excluded all medical cause of the coma, surgical advice was requested. At my visit, on April 14th, as the history of trauma was still wanting, expectant treatment was advised, but on the following day, after diligent inquiry among patient's friends, it was ascertained that he had had an altercation. On my second visit, on April 15th, having ascertained this fact, I advocated immediate exploration of the skull. Although the symptoms of general compression had not increased and there was still absence of focal symptoms, the correctness of my advice was

proved by the operation. The presence of great intracranial pressure was a striking feature of this case at the time of operation, when the brain pressed into the trephine opening after the evacuation of the clot. This intracranial pressure continued for some days after operation, as is evidenced by the prolapse of the brain at the trephine opening found on the tenth day after operation.

The successful result in this case was due in a great measure to the removal of the clot, but the free drainage of bloody serum following the operation contributed in a great degree to keep the intracranial pressure within the desired limit.

As mentioned above, the main reason for advising operation was the history of trauma, and had I known at my first visit that the patient had been struck with a club, I should have advised immediate exploration of the skull. The epileptic convulsions which appeared after the operation were most likely the result of the cortex laceration or, maybe, due to adhesions between the scalp and the cortex, as the dura was not completely sutured. In view of the improvement, however, which has attended the use of bromides, further surgical interference is at present not indicated.

Up to within a few years the treatment of subdural hæmorrhage has, as a rule, been purely expectant, but the opinions concerning the advantages of the operation have since changed. Contusion of the brain is not so frequent an accompaniment as was formerly supposed, and in the opinion of some its presence is not only not a contraindication, but by removal of the clot the cerebral circulation is improved and thus a beneficial influence is exerted on the accompanying contusion. The results of operation have been satisfactory, and the percentage of recoveries rather large. Of the seventy-two cases collected by Bowen, there are twenty-eight of recovery and forty-four deaths. Twenty of the fatal cases were not operated on for various reasons, such as mistaken diagnosis, suspicion of brain contusion, etc. Thus there were fifty-two cases operated on with twenty-eight recoveries, and

over fifty per cent. of the operations were successful. A rather significant fact, and one which suggests that the results might have been better, was that in ten of the twenty non-operated cases death was due solely to compression from hæmorrhage, a condition favorable for operation. Bowen's statistics also show that contusion of the brain was an accompaniment in only one-half of the cases in his collection. Finally, the injurious effect on the cortical centres and on the spinal cord of the long-continued pressure should not be forgotten, and unless it is promptly relieved the patient is very liable to be left with permanent lesions.

As regards the more frequent resort to exploratory operation in the treatment of traumatic intracranial hæmorrhage, it would seem that it is clearly indicated. While surgeons are united as to the necessity of the operation in injuries of the middle meningeal artery, which practically are the sole cause of extradural hæmorrhage, they are still doubtful as to the adoption of a similar treatment in cases of subdural hæmorrhage. This view is inconsistent, in that it is only rarely that the symptoms are sufficiently characteristic to allow of a differential diagnosis, and very frequently it is only by exploration that the source of the hæmorrhage is ascertained. The result of hæmorrhage, whether it be extradural or subdural, is always compression of the brain by the clot, and the sole indication of treatment is removal of the clot, and checking the hæmorrhage. The important point for the surgeon is to recognize the presence of intracranial hæmorrhage and if the symptoms of compression are severe, to immediately relieve the compression, no matter what may be the source of the hæmorrhage.

While an advocate of resorting more frequently to operation, with the idea that thereby we will save many cases otherwise doomed, I am not in accord with those who advise that the skull should be opened in every doubtful case.

REPORT OF A CASE OF TUMOR OF THE CAROTID BODY.*

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THE first person to suspect the existence of the carotid body seems to have been the great Haller; and from his time on there has now and then been a suggestion by some anatomist of a knowledge of the presence of the structure. In 1833 Mayer gave a description of it and pointed out its common situation in the bifurcation-angle of the carotid artery. He described it as about the size of a grain of rice, and as attached to the carotid vessel; and mentioned some other facts in relation to it. Luschka, in the early 60's, made a microscopic study of the gland; and since that time, Arnold, Kölliker, and others have written about it.

One thing seems to be sure: that the carotid body is not invariably present. In fact, it is frequently absent. Funke¹ points out that it is enclosed in a fibrous capsule, and that a fibrous band comes from the capsule and divides the body into two parts, other bands from the capsule separating each half into lobules. This fibrous tissue contains a multitude of blood-vessels. Funke further points out that the lobules contain cell-collections without definite arrangement, that only rarely do they resemble the structure of a gland, and that in all parts of these lobules blood-vessels are demonstrable. The same observer believes that the lobules result from proliferation of the endothelial cells of the blood-vessels.

To-day, we should describe the carotid body as a structure placed in the bifurcation of the common carotid artery; to the inner side of this vessel, on a lower level than the bifurcation;

* Read before the Philadelphia Academy of Surgery, May 7, 1906.

¹ Am. Med. July 16, 1904.

or on the posterior surface of either the external or the internal carotid. It probably always takes origin from the sheath of the internal carotid. In human beings, it is frequently absent. At least it is frequently absent in those beyond puberty. It is encapsuled in fibrous tissue, is fastened to the sheath of the internal carotid, and the gland with its capsule is embedded in a considerable amount of fat. In shape, it is oval; in color, reddish brown. Its size when not enlarged is about that of a grain of corn. The septa from the capsule divide the organ into follicles, or cell-balls; and these cell-balls are composed of numbers of endothelial cells and capillary blood-vessels. A small branch, several branches, or many branches from the carotid pass into the carotid body; and the carotid plexus of the sympathetic nerve is in very close relation with the body. This structure has been studied, of late, by John Funke, Paltauf, Reclus, Marchand, and others. Its function is unknown.

Occasionally tumors arise in this structure; and Dr. Funke, in the previously-quoted article, has collected fifteen cases. In his series, it is shown that the tumors may occur in adolescents or in adults, and in either sex. He quotes the observation of Heinleth that the carotid body undergoes development until puberty, when it ought to atrophy; but that if it fails to atrophy, but continues to grow, a tumor forms. Such a tumor grows very slowly, requiring years to reach any considerable size, and never becoming very large. Sooner or later, however, rapid growth is liable to begin; and it is usually only after years of growth, and when this sudden rapidity of growth has alarmed the patient, that a surgeon is called in.

Early in the case the growth is entirely free from pain, but in the later stages there may be pain in the tumor, pain radiating into the ear, dysphagia, and—as has been pointed out—perhaps pupillary contraction of the same side and facial vasomotor disturbance. In a large majority of the reported cases, there has been distinct transmitted pulsation in the tumor. The skin is movable over the growth; the tumor may be moved from side to side, but not up and down; and there is usually a systolic murmur over the tumor.

I have recently had, in the Jefferson College Hospital, a case of this rare and interesting trouble, and a diagnosis was made before operation. The record of the case is as follows:

The man was 52 years of age. Over twenty years ago he noticed a very small lump on the right side of his neck. He said that when he first found it this lump was not larger than a grain of corn. During many years it slowly but certainly increased in size. A few months ago it began to grow rapidly, and within less than a year of rapid growth it attained the size of a small egg of a hen. He also began to have some difficulty in swallowing, had attacks of redness of that side of the face, and occasionally suffered from pricking pain in and around the tumor. The rapid growth alarmed him, and he decided to consult a surgeon.

An examination showed the tumor to be in the superior carotid triangle, having its lower border on a level with the upper margin of the thyroid cartilage, and its upper border passing to about the level of the angle of the jaw. The external jugular vein was distinctly visible passing over it. The skin was freely movable over the tumor; and the tumor itself was movable from side to side as though on a hinge, but was not movable from above downward or from below upward. The growth was not tender on handling, but was the seat of very marked pulsation, which investigation demonstrated not to be expansile pulsation, but a lifting of the growth by the pulse of the carotid. The tumor was hard, but somewhat elastic, being, however, softer at some points than at others. It was smooth, but apparently lobulated on the surface. On listening with the stethoscope, a systolic murmur could be made out when the stethoscope was pressed firmly upon it; but this was not more manifest than it was on the carotid artery itself, when the same maneuver was executed.

It was evident that this tumor was not an aneurysm, from its long history, from its hardness, from the absence of genuine bruit and expansile pulsation, and from the fact that pressure on the artery did not cause the mass to diminish in size. It was not a cyst, because it was evidently a solid body. The question of a misplaced fragment of thyroid tissue was considered; but the density, the history, and the vascular phenomena led to the rejection of this idea. It was too hard and too deep for a fatty tumor. Its movability, its long history, and the phenomena

of pulsation were against sarcoma; and the long history, without any change in consistency and without the involvement of the overlying parts, was considered to rule out lymphatic glandular trouble.

I advised operation, on account of the rapid growth then taking place and the apparently inevitable disaster, if this rapid growth were permitted to continue unchecked.

After having exposed the tumor by an incision at the anterior margin of the sternocleidomastoid, and while endeavoring to free it, I was greatly embarrassed by the profuse bleeding. The fatty tissue about the tumor and the capsule of the tumor oozed continuously from numberless places. The bleeding was both arterial and venous. Forty ligatures failed to arrest the bleeding.

After exposing the tumor thoroughly, the growth was found to be in and around the angle of bifurcation of the common carotid; and it embraced the vessels so completely that it was out of the question to free the growth from them as I had hoped to do and as was done in 3 reported cases. It was equally impossible to abandon the operation, because the persistent hæmorrhage barred such a road of retreat. Consequently, the operation was proceeded with.

The common carotid artery was tied with two ligatures below the growth, and was divided between the ligatures. The distal stump of the divided artery was grasped with forceps, and used as a handle in lifting the tumor while the growth was being separated. The tumor, with the beginnings of the internal and external carotid arteries, was freed from its attachments. During this separation the internal jugular vein was badly torn; and it was necessary to ligate it. When the portion of the external carotid artery above the tumor was reached this vessel was tied and divided. Between the upper border of the tumor and the base of the skull there was barely room to ligate the internal carotid; it was with great difficulty that it was ligated and divided, and I barely escaped the accident met with by Mikulicz, who found the tumor had entered the bony foramen and was obliged to cut away bone to stop bleeding. The wound was closed with drainage.

The man had lost much blood and was considerably shocked. He reacted but slowly from the anæsthetic. Eight hours after the operation he developed a weakness just short of complete paraly-

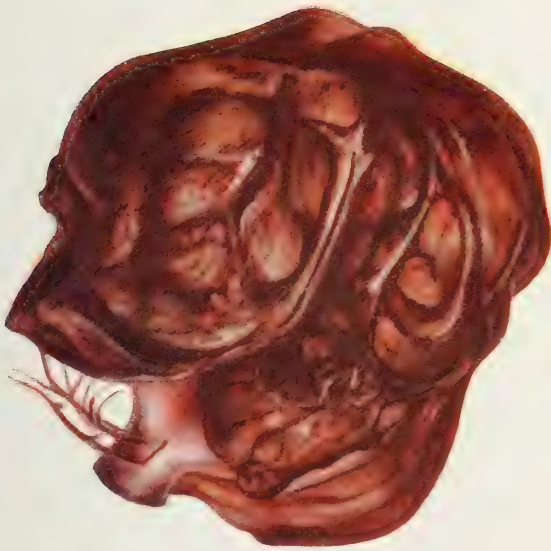


FIG. 1—Case XXVI.

sis of the left arm and leg, the face escaping. He was also found to have a very low and extremely hoarse voice. The day after the operation, the voice continuing low and hoarse, the throat was examined; and relaxation and œdema of the right vocal cord were observed by Dr. J. Leslie Davis to exist. These conditions were due to paralysis of the cricothyroid muscle from injury of the superior laryngeal nerve.

For many days there was a copious flow of mucus from the larynx and the bronchi; and, owing to the anæsthesia of the mucous membrane, the patient had great difficulty in expelling this mucus. For some time there was considerable difficulty in swallowing, probably also due to injury of the superior laryngeal nerve, which, it will be remembered, also goes to the inferior constrictor of the pharynx. For the first few days after the operation there was a copious flow of lymph from the wound, showing that large lymphatic vessels had been divided. This ceased about the end of the first week.

On the eighth day after operation complete hemiplegia suddenly developed. The left arm and leg were completely paralyzed; the face was much drawn; and the man was dull, drowsy, and sometimes stuporous, but never unconscious. It was the opinion of Dr. Alfred Gordon that this attack was due to embolism, in all probability in the internal capsule; and the first and milder attack was thought to have been due to thrombosis in the cortical vessels.

The day after the onset of the hemiplegia, the man was found to be suffering severely with dyspnœa and repeated choking fits, in some of which it seemed that he must strangle. Great quantities of mucus passed into the throat, and there was the greatest possible difficulty in ejecting it. Examination of the left lung, made by Dr. John C. DaCosta, Jr., developed the fact that at least half of the lung was in a state of complete collapse, containing no air whatever. The right lung was entirely normal. The patient stated that he had had an exactly similar pulmonary condition a number of months before. This had come on from an unknown cause, and had almost killed him. The atelectasis produced great discomfort for a number of days, but was gradually recovered from; and the lung is now normal, so far as physical signs indicate. It seems probable that the laryngeal anæsthesia was responsible for this condition,

and that either plugs of mucus had passed into the lung and blocked the bronchi, or that some elements from the food had passed the larynx.

Present Condition (8 weeks after the operation).—A marked, but fading, left hemiplegia exists. The man can move the leg, and can stand upon his legs, if he supports himself with a cane or a crutch. He can move the elbow, the shoulder, and the wrist, and can flex the hand; but the extremity is still very weak. He has occasional paroxysms of violent shooting pain in the arm and in the leg. The wound is completely healed and not tender. The voice is hoarse and low, and the right vocal cord is œdematous and relaxed; and Dr. Davis is of the opinion that this is due to injury of the superior laryngeal nerve.

Conclusions.—It is thus seen that the operation of removing a tumor of the carotid body is a very formidable one. The surgeon may have to tie all the carotid arteries; and he may damage a nerve or nerves, with subsequent unfortunate results. The ligation of the common carotid artery is an extremely dangerous procedure; and it is one of the few operations in which the mortality does not seem to have been greatly diminished since the days of Sir Astley Cooper, who did the first successful ligation of the common carotid, in 1808. Mr. Richard Barwell, in his article on Aneurysm in "Ashhurst's International Encyclopedia of Surgery," published in 1889, gives the mortality of 107 cases of ligation of the common carotid for aneurysm as 25.23 per cent. Some more modern authors estimate the death-rate as in the neighborhood of, or over, 30 per cent.; and it is thus seen what a responsibility it is, even at the present time, to tie this vessel.

The danger of death is, however, not the only danger in ligating the common carotid. My case shows that hemiplegia may follow the operation. It has long been known that a considerable percentage of those on whom ligation has been performed suffer subsequently with cerebral symptoms. In some of the cases, these symptoms have been produced by thrombosis; in others, by embolism; and in still others, by cerebral softening. Pilz has pointed out that 32 per cent. of the cases

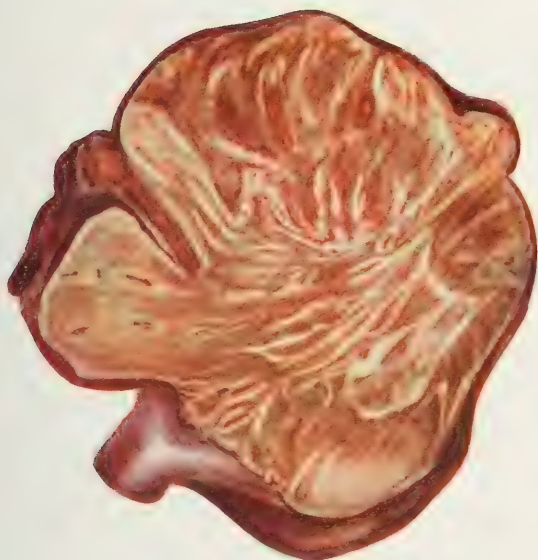


FIG. 2.—Case XXVI. Section.

in which the common carotid has been ligated exhibit brain symptoms, and that 56 per cent. of the cases that show brain symptoms die. Zimmermann says that in 11 per cent. of the cases there is softening of the brain, and that 26 per cent. of the cases show brain symptoms. There is much greater danger of brain symptoms when the operation is performed on the elderly or middle-aged than when it is done on the young. In older subjects, arterial atheroma may interfere with the distension of certain vessels whose integrity is necessary to bring sufficient blood from the vertebrals, from the other internal carotid, and from the terminations of the external carotids. Failure in a satisfactory restoration of circulation is most liable to occur when profuse bleeding greatly lowers the blood-pressure, as it did in this case. When such cerebral change ensues, it does not necessarily mean death. In fact, it may be recovered from, partially or completely. Usually, however, the condition is permanent and progressive, and finally results in death. In Funke's series of 15 cases of tumor of the carotid body, there were but two deaths; one from bronchopneumonia, and one from secondary hæmorrhage. There may be added to this, Keen's unreported case, which makes three deaths in 16 cases. In Funke's series, there was but one case of hemiplegia. In Dr. Hearn's case, however, which is not recorded in the table as one of hemiplegia, the patient died two months later; and Dr. Hearn tells me that, although he did not see the case, he believes from what he has learned that the man died of cerebral softening. So, out of 13 recoveries in Funke's cases, to which my cases may be added, making 14 recoveries, there were two cases of hemiplegia and one of cerebral softening.

Owing to the great danger in ligating the common carotid, surgeons have sought to avoid it in removing carotid tumors. The reported cases show that almost always all the carotids must be ligated. Albert, in his case, was obliged to ligate only the external carotid, being able to remove the growth from the carotid sheath. In his case the growth recurred within one year. In Heinleth's case and in that of Cuneo, no ligations were necessary, owing to the free separability of the tumor.

Out of Funke's 15 cases, only three are recorded as not requiring ligations of all the carotids; and when Keen's case and mine are added to this list, they make 17 cases, in 14 of which ligation of all the carotids was necessary.

Another danger of the operation is nerve-injury. In my case, the superior laryngeal was injured. In all probability, it is a piece of this nerve that we find incorporated in the specimen. In Funke's 15 cases, there were six cases in which the nerves were injured—the sympathetic, the pneumogastric, the hypoglossal, the facial, or the recurrent laryngeal. Two cases out of the 15 exhibited postoperative paralysis of the vocal cord of the side operated upon.

It is thus evident that the operation of removing a carotid tumor is an extremely dangerous one, and is not to be lightly undertaken. We agree with Reclus that one should not touch these growths, unless they are productive of danger to life. So long as they are merely slowly progressing, they had better be let alone. It is only when they begin to grow rapidly that one should remove them, and then he must, in spite of the danger. In my case, the tumor was infiltrating the surrounding structures, and would unquestionably have killed the man, if allowed to remain. Surgeons must be wide awake to the existence of such growths. Without carefully examining every tumor in this region of the neck, one could easily be led into operating with a light heart for some supposedly trivial condition, and then find oneself suddenly so far advanced in attacking a carotid tumor that retreat would be impossible, and probably all the carotids would have to be tied. The diagnosis is possible in many cases. It was made in several of the cases in Funke's list, and it was made in the case now reported. The pictures exhibit the tumor that I removed, and Dr. Funke's report of the specimens follows:

Macroscopic Description.—The specimen is a lobulated mass, measuring 5 by 5 by 4 cm.; weight 104 gmm. It is dark red in color, encapsulated, distinctly elastic in consistency at some places and flabby at other places. The mass is irregular; it is composed of three large nodules, each being 2.5 cm. in one diameter and 2 cm. in the other. The smaller

nodules present do not attain a diameter of 0.5 cm.; they are especially seen on the anterior surface. This surface contains many depressions varying from 0.5 to 1 cm. in depth; these depressions are incident to the pulling of the capsule into the tumor substance. The lacerated tissue present adds to the irregularity of the anterior surface. The posterior surface is less irregular; it is lobulated, however, and the nodules are more conspicuous here than upon the anterior aspect. Laceration and

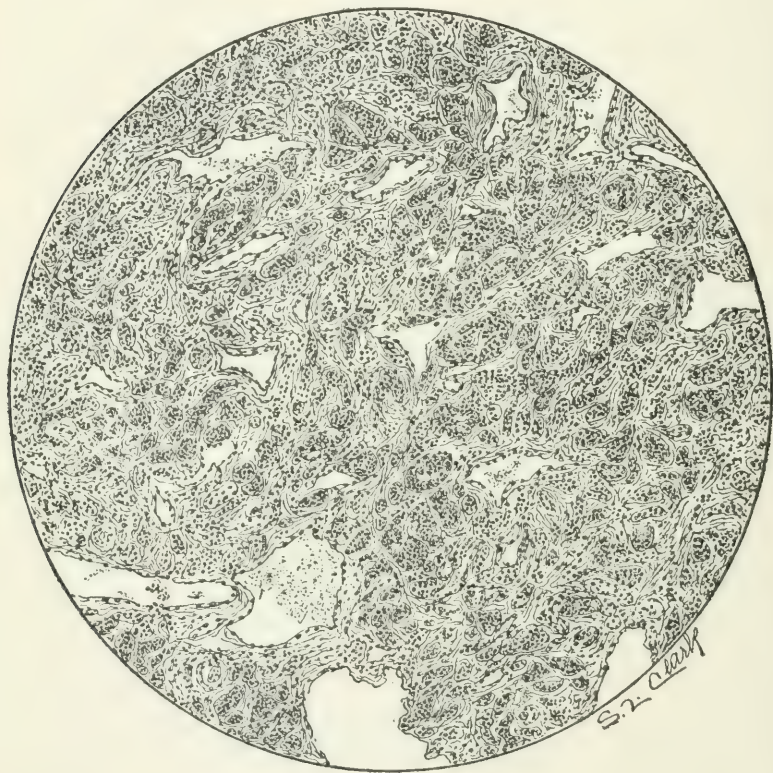
FIG. 3.



fragmentation of the capsule is marked. Lying upon this surface, not more than 2 cm. from the margin, is a greyish-pink cord-like piece of tissue apparently made up of smaller cords; the consistency and the architecture of this structure resemble a nerve. It is not firmly attached to the tumor-mass. Lying upon this surface, but only near one end, is a large vessel which from its general structure appears like the common carotid artery and which contains, 0.5 cm. from the free margin, a liga-

ture. One centimeter above the ligature the vessel divides; one branch curves slightly toward what was described as the anterior surface and then tunnels the mass between two of the nodules described. Only 0.5 cm. of this branch is visible, but upon dissection it is found to traverse the mass nearly parallel with the anterior surface and but 0.7 cm. from it. The other vessel curves slightly backwards and then tunnels the mass near the opposite side of the specimen, but runs parallel and very close to the

FIG. 4.



posterior surface. Both vessels are easily identified at what is presumed to be the superior portion of the tumor, and both vessels as well as the common carotid artery are firmly attached to the tumor mass. The first vessel described in all probability was the external carotid, since it gave off a small branch near its point of severance.

Dissection showed that the three larger nodules mentioned are firmly united at a point posterior to the bifurcation of the vessel mentioned. The one nodule is united to the other two at this point and along the

entire margin of but one nodule by means of a pedicle; the internal carotid passes between these nodules and is anterior to the pedicle. The other two nodules are for the most part situated in the fork formed by the branching vessel. Dissection also reveals that the smaller nodules are produced by the septa which penetrate from the capsule into the underlying tumor mass.

The cut surface has a lobulated appearance; it is granular, reddish-brown in color, but traversed by greyish bands; some of these bands are dense and comparatively broad. The cut surface as well as the capsule contains many small opened-mouthed blood-vessels; so numerous are they the surface has a porous appearance.

Portions of the tumor were fixed in Zenker's fluid and the remainder was preserved in Kaiserling's fluid. Sections were made and stained with hæmatoxylin and Van Gieson's method for connective tissue, by Mallory's reticulum stain and with polychrome-methylene blue.

Histology.—One margin of the sections is covered by a dense capsule composed by wavy fibrous connective tissue, in which are few lymphoid and spindle-shaped cells and few strands of elastica, together with many blood-vessels. From the capsule fibrous septa penetrate the underlying tumor-mass and divide it into lobules, which are again divided into alveoli. The fibrous septa are very broad and are found in cross and in longitudinal sections; they contain few lymphoid and spindle-shaped cells and large and small blood-vessels. Many of the last-named structures contain erythrocytes, and possess well-formed and thick walls.

The walls of the alveoli are in some instances formed by delicate connective-tissue strands, evidently constituents of the septa already mentioned; the greater number, however, are formed by delicate capillaries, branches of the vessels found in the septa. Occasionally these capillaries are composed of a single layer of endothelial cells; in other instances the endothelial lining is supported by a few strands of fibrous connective tissue. The alveoli are fairly uniform in size and very difficult to outline in many places, owing to the number of contained cells. The cells in the alveoli vary somewhat in size, ranging from 15 to 25 microns in diameter; they are irregular in outline, many are polyhedral and few are oval. The protoplasm contains no cell membrane; it is finely granular and acidophilic. The nuclei are comparatively large and intensely basophilic. The nuclear membrane is conspicuous. Occasionally few red blood-cells are found among the tumor-cells. In not a few alveoli the tumor-cells show degenerative changes. Few chromaffine cells are present.

Diagnosis.—Endothelioma: this is the type of tumor to which most writers on the neoplasms of the carotid gland apply the term "perithelioma." From the fact that the growth has invaded the vessels and the surrounding tissues it should be looked upon as malignant.

SHORTENING OF THE ROUND LIGAMENTS BY SUBPERITONEAL VENTRO-APONEUROTIC FIXATION.¹

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IN common with other favorite procedures in pelvic and abdominal surgery the operation about to be described for holding the uterus in a forward position attained its present stage of perfection through a process of surgical evolution, in which the ingenuity of Gilliam and Ferguson proved originating forces, while the fertile brain of a Simpson, and the surgical judgment and operative skill of a Montgomery played the parts of modifying factors. Now while the recognition of the operation by the name of its originator, compounded by the names of those who eliminated its original defects and improved and simplified its technic, may be of interest as a matter of surgical history and reflect the glory of those to whom credit is due, it must be admitted, that the practice of thus naming surgical innovations has no value scientifically, and, as many of us know, proves highly confusing to the student, hence the designation of the procedure as indicated by the title of this paper.

Shortening of the round ligaments by subperitoneal ventro-aponeurotic fixation, signifies in a few words the main anatomic and surgical features of a procedure that is again directing the attention of the profession to the feasibility, as well as the advisability, of replacing the retro-deviated uterus in suitable cases by restoring and enhancing the physiologic efficiency of its natural supports.

The principles underlying this comparatively new

¹ Read before the Philadelphia Obstetrical Society, March 1, 1906.

operation have gained in favor with many surgeons and not a few in their eagerness to pose as originators have described devious routes and complicated methods for the accomplishment of practically the same thing—*i.e.*, fixation of the inner third of the round ligaments to one or more of the ventral structures immediately above the pubic bone by subperitoneal transition.

The operation as finally perfected by Professor Montgomery and extensively practiced in the wards of the Jefferson Medical College Hospital for more than two years is simple in detail, and after mastering its technic is as easily and readily done as a ventro-suspension. The abdomen is opened and coexisting complications are dealt with as may be indicated. If the uterus is retrodisplaced and a forward inclination is desired, each round ligament about one-and-a-half inches from its uterine attachment is picked up and temporarily held with catch forceps; a strand of strong cat-gut fifteen to eighteen inches in length is passed beneath each ligament at these points, thus forming loops in which the ligaments rest while the two ends of each strand are secured by hæmostats. The round ligament of one side is next seized with a hæmostat immediately external to the part held by the looped strand, and this is handed to an assistant with instructions to render the distal portion of the ligament with its peritoneal investment tense by traction toward the median line of the abdomen. Both ends of the corresponding looped strand are now drawn through the eye of a Deschamp ligature-carrier. The peritoneum overlying the anterior leaflet of the broad ligament immediately below the hæmostat held by the assistant is picked up with a toothed-forceps and button-holed with a scissors, and through this opening the armed carrier is introduced, passing outward between the folds of the broad ligament following the course of the round ligament. Upon reaching the abdominal wall the tension hæmostat is removed while the point of the carrier is thrust through the abdominal musculature and aponeurosis about three-fourths of an inch above the margin of the pubic

bone and about one-and-a-half inches from the median line. The ends of the strand are now released from the eye of the carrier external to the aponeurosis and the carrier itself is withdrawn. Traction upon the strand breaks the peritoneal investment of the ligament held by its loop and drags it to the under surface of the aponeurosis through which it is teased by enlarging the perforation with the spreading points of a scissors. The round ligament of the opposite side is next dealt with in a like manner. The exposed portion of each round ligament overlying the abdominal aponeurosis is now under the control of the will of the operator for shortening or lengthening either its proximal or distal portion, the same as might be done with the exposed loop of a tendon by sliding same within its sheath. After securing the necessary tension of both ligaments for holding the uterus in a median forward position, the proximal side of each loop is sutured to the abdominal aponeurosis to the extent of about three-fourths of an inch. The traction strand is withdrawn following the fixation of each ligament. The abdominal opening may be closed in accordance with the choice of the surgeon.

The crescentic abdominal incision, including the skin, fat, and aponeurosis, with longitudinal separation of muscle fibre and peritoneum, as suggested by Stimson and extensively practiced in the gynæcological wards of the Jefferson Hospital, offers undoubted advantages in the performance of this operation in uncomplicated cases, especially in subjects with thick abdominal walls. A better view of the anterior pelvic structures is thus obtained and the manipulation of the ligaments facilitated, but its disadvantages in dealing with complicating new growths of large size or inflammatory processes with unyielding adhesions in the posterior pelvic segment are at once apparent to any one contemplating the limited range of exposure afforded by the opening.

Upon the completion of the operation the uterus occupies a well-poised median anterior position, and other conditions being equal, it simulates the normal in its re-

sponsive behavior to the influences of the respiratory act, to varying degrees of intra-abdominal pressure, as well as to the repletion and depletion of rectum and bladder. These changes obtain because the organ itself is in no sense directly fixed by sutures or artificial stays, but is supported by that portion of the round ligaments corresponding in structure with the musculature of the uterus, of which it may in truth be said, they are a continuation and form a part, and possess in no slight degree, therefore, the properties of elasticity and contractility, which, taken in connection with their cord-like form, and with the integrity and function of other uterine supports, are factors of first importance in securing the elastic and mobile equilibrium of the organ referred to, and in maintaining its normal prevailing tendency to a forward inclination in the presence of an ever-changing cycle of physiologic disturbances that tend to its displacement.

The segment of each ligament thus utilized is not alone the more muscular, but likewise the heavier and the stronger portion of its structure in every other respect, so that subsequent overstretching with a recurrence of the displacement is hardly to be feared and has not as yet been observed.

Compensatory evolution and involution of the ligaments during pregnancy and the puerperium are assured, while their extensive and firm union with the unyielding structures of the abdominal wall renders their detachment during the stress of parturition, or from any other cause, among the rarest of possibilities. In the absence of utero-abdominal attachments dystocia, as a result of the operation, can not occur.

The button-hole opening in each broad ligament is necessarily plugged and its edges inverted by the round ligament in its subperitoneal transit toward the abdominal wall, so that in cases uncomplicated by extra-uterine disease requiring additional surgical attention there are no raw surfaces, no preternatural openings through which knuckles of intestine may slip and become strangulated, nor

is there any other lesion left in the pelvis as a direct result of the operation for the formation of unfortunate adhesions and their retinue of possible evils.

The disposal of the slack in the broad ligaments by the necessary traction upon the round ligaments in pulling them through their newly-formed channels at once raises the prolapsed ovaries to a higher plane and a better circulation level.

If the displacement of the uterus is a partial expression of a general disturbance of the statics of the abdominal and pelvic viscera, the operation, if at all indicated, merely becomes one of several expedients to which recourse should be had for improving the patient's condition. In the presence of complicating diseased conditions requiring operative interference, the displacement may, or may not, prove a factor demanding special consideration. Curettement of the uterine cavity if indicated, and requisite plastic work on the cervix and vagina, should, as a matter of course, precede the abdominal operation.

The first operation as described in this paper was performed by Professor Montgomery at St. Joseph's Hospital, January 11, 1904, and he has repeated the procedure in 141 additional cases. I, myself, continued to practice ventro-suspension until convinced of the superiority of the new method, after having assisted in the operation many times and examined patients many months subsequently to determine the time value of the procedure. Within the past eleven months I have done the operation in 26 cases without an unfavorable incident and with the most gratifying results.

Three instances of pregnancy and labor following this procedure have come under the observation of as many competent practitioners of my acquaintance, all of whom reported that nothing unusual was noted in any of them, and that the subsequent behavior of the uterus was in nowise contrary to what was to be anticipated under normal conditions,—*i.e.*, perfect involution with the maintenance of a mobile forward inclination of the organ.

AN EXPERIMENTAL STUDY OF SUTURE OF ARTERIES WITH A DESCRIPTION OF A NEW SUTURE.¹

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THE methods of repair of arteries hitherto proposed are as follows:

I. MECHANICAL METHODS.—(a) Adhesive plaster methods, devised by Dr. G. E. Brewer. Advantage: The rapidity of application. Disadvantages: 1, A foreign substance is left in place; 2, secondary hæmorrhage occurs frequently; 3, obliteration of the vessel is common from too much pressure. (b) Abbe's method. The introduction of a glass tube in the lumen with suture of the artery. Advantage: Very slight chance of secondary hæmorrhage. Disadvantages: 1, The tube is a foreign body and by its presence causes irritation of the intima and produces thrombosis at the ends of the tube; 2, the tube may ulcerate its way out.

II. SUTURE METHODS.—(a) Invagination method devised by Dr. J. B. Murphy. Advantages: It gives a double thickness of the artery at the line of approximation. Disadvantages: 1, The artery is necessarily stretched; 2, the operative procedure difficult and long; 3, the lumen is narrowed; 4, the end of the artery allows fibrin ferment to enter the bloodstream; 5, fringes of intima hang in the blood current and assist in coagulation. (b) Suture of the outer two coats only. Advantages: None, over the through-and-through method. Disadvantages: 1, The blood can dissect its way between the

¹ Read before the Philadelphia Academy of Surgery, May 7, 1906.

coats of the artery and cause an aneurism; 2, fibrin ferment from the arterial walls has free access into the blood-stream; 3, fringes of intima hang in the blood-stream and assist in coagulation. (c) Through-and-through method. Advantage: Easy to perform. Disadvantages: 1, The suture is exposed to the blood-stream; 2, fringes of intima hang in the lumen. In the method now to be described attention is called to advantages: 1, The suture does not protrude in the lumen of the artery; 2, fibrin ferment cannot get from the ends or cut surfaces of the artery into the blood-stream; 3, the liability to secondary hæmorrhage is lessened by the double line of suture. Disadvantages: We have not observed any.

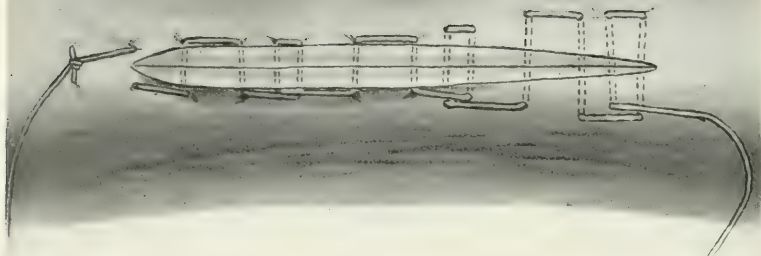
Description of the Suture.—Pagenstecker's thread Number One is used in the finest sewing-needle the thread will pass through. The clamps used are very limber-bladed forceps, devised by us especially for this work in order to avoid crushing the intima. The blades are covered with rubber tubing. (Figure 1.) Dissecting forceps are used to hold the edges of the artery. The suture can be used for a longitudinal, oblique or transverse (complete or incomplete) cut in the artery.

Method of Suturing a Longitudinal Cut.—(Fig. 2). The clamps are applied 2.5 cm. above and below the cut. The suture is started 1.5 mm. above the cut edge, the suture is passed through the outer two coats and tied, the end of the suture is grasped by a hæmostat, the needle is next passed through all the coats of the artery on both sides 1.5 mm. below the first suture and 1.5 mm. from the cut edge; the suture from now on is a continuous mattress with the dropping back one-half a suture length every third suture until the end of the incision is reached, then the suture is passed through the outer two coats 1.5 mm. below the lower end of the cut and a half-hitch made to tie the suture. The same suture is continued as a whip-stitch over the edges of the artery outside of the mattress suture until the starting-point is reached, when the two ends of the suture are tied. The artery is grasped in a gauze pad, the distal clamp removed, then the proximal clamp and the artery

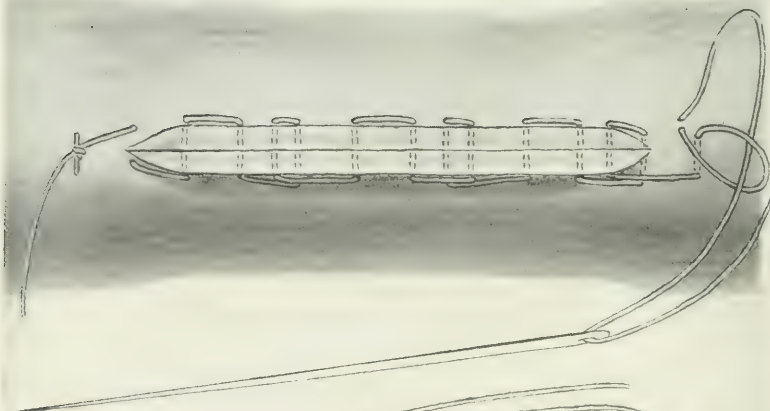


FIG. 1.—Special artery-clamp.

A



B



C

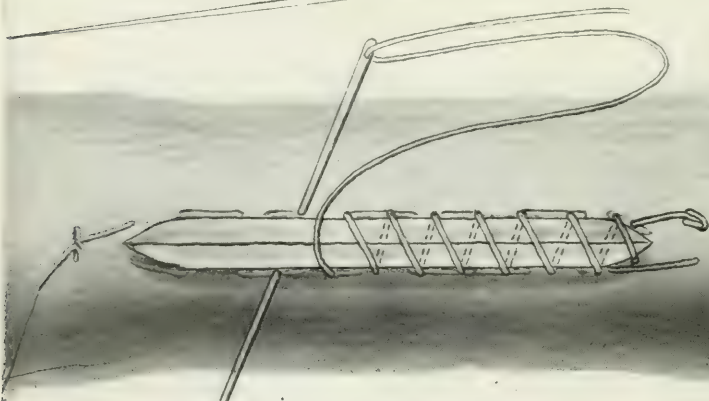


FIG. 2.—A, suture inserted and pulled tight in the lower half; B, suture inserted and pulled tight throughout; half-hitch made but not tightened; C, mattress suture pulled tight and half-hitch made, whipstitch partially inserted but not pulled tight.



RE. of incomplete transverse Wound

FIG. 3—Suture of incomplete transverse wound.

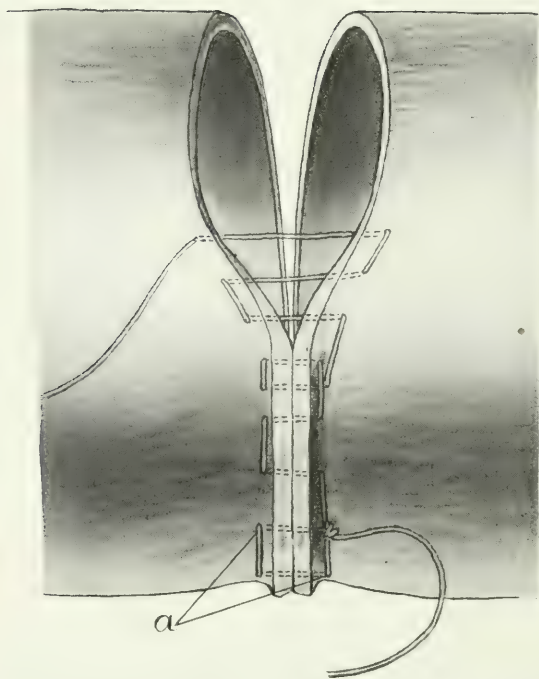


FIG. 4.—Suture of complete transverse wound ; A, mattress suture.

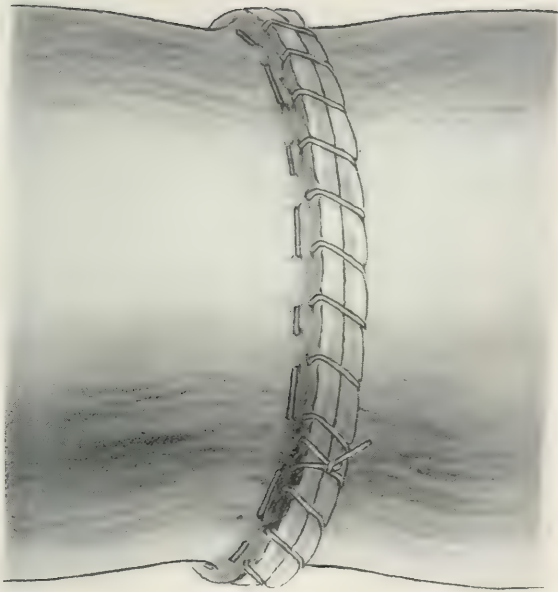


FIG. 5.—Suture of complete transverse wound, finished.

is dropped back in place and the deep fascia sutured around the line of approximation.

The method of suturing an oblique cut is practically the same as the longitudinal.

The Method of Suturing a Transverse Incision Half Way Through the Artery.—(Fig. 3.) The clamps are applied 2.5 cm. above and below the cut edges. The suture is started 1.5 mm. from the lateral end of the cut and passed through the outer two coats and tied; the end of the suture is grasped with a hæmostat. The suture is continued as a continuous-mattress suture, dropping back one-half a suture every third stitch until the opposite end of the cut is reached, then the suture is passed through the outer two coats and a half-stitch made to tie the suture; the same suture is continued back over the line of suture as an over-hand whip-stitch outside the mattress suture until the starting-point is reached, when the two ends are tied. The mattress suture should be 1.5 mm. from the cut edges at all times. The deep fascia should be sutured around the line of approximation.

The Method of Suturing a Complete Transverse Division of an Artery.—(Fig. 4, 5.) The clamps are applied as before. The cut edges of the artery are grasped with dissecting-forceps and the suture is passed through the upper edge of the artery from without in and through the lower end from within out; the needle is then reversed and brought back 1.5 mm. to one side of the former suture and tied. (This suture is really a single-mattress suture.) The suture is continued as a continuous-mattress suture, dropping back half a stitch every third suture until the starting-point is reached, then a half-stitch is made and the suture continued back as a whip-stitch until the starting-point is reached again; then the two ends are tied. The suture is started on the anterior surface near the handles of the clamps. When the suture reaches the farther side of the artery the handles of the clamps are taken from the lower portion of the wound and placed in the upper portion; in this way the surface of the artery which was anterior is now posterior, and the suture can always be kept in sight.

EXPERIMENTS.

CASE I.—Black horse, aged 20. Condition was very poor. The anæsthetic was chloral internally and chloroform by inhalation. An incision 20 cm. long was made on the left side of the neck, the carotid artery was found and the clamps were applied. A small vessel arising from the under surface of the artery was clamped and ligated. A longitudinal incision 4.5 cm. long was made in the artery. The artery was sutured, the clamps were removed and no hæmorrhage occurred. After the deep fascia was sutured around the line of approximation, the artery could be seen pulsating. The wound was sutured with through-and-through sutures of silkworm-gut. The horse died from the effects of the anæsthetic three hours after the operation. Through a mistake of the attendant, the specimen was not recovered.

CASE II.—Black horse, aged 20. Condition was very poor; there were several sloughing wounds and sinuses over the body. The anæsthetic was chloral and chloroform. An incision 22.5 cm. long was made on the right side of the neck; the carotid artery was found and the clamps were applied. The artery was divided transversely two-thirds the way through. The artery was sutured, the clamps were removed and no hæmorrhage occurred. After the deep fascia was sutured around the line of approximation, the artery could be seen pulsating. The superficial wound was closed with through-and-through sutures. The pulse was equal on both sides. Twenty-four hours after the operation the pulse was good and equal to that on the opposite side; the horse was unable to get up. Forty-six hours after the operation the pulse was equal on both sides; the horse was unable to get up and was killed by pithing. When the incision was opened up the wound was found to be infected; the artery was removed and examined; a very small lateral thrombus was present, but the lumen was not decreased. (Fig. 6.)

Pathological Report.—Gross specimen, preserved in a solution of formaldehyde, shows a portion of an artery dissected free from the periarterial tissues, the wall of practically normal thickness and without apparent gross trace of any marked hyperæmia. The vessel laid open shows the intima practically normal, save at site of the wound; the wound a partial transverse (slightly oblique) incision of the circumference, marked by a small clot extending in valvular fashion into the interior, and attached at the line of incision. This clot probably interfered but little, if any, with the flow of blood, and is apparently organized. The texture of the tissue of the wall shows no important gross changes.

Microscopic.—Section longitudinal, transverse to the line of operative wound. As seen in the section there extends from the line of closure of the incision a flap-like (valvular) thrombus into the lumen of the vessel, granular and fibrinous in structure, containing numerous scattered polynuclear leucocytes and a few eosinophilic cells. The wall of the artery is slightly thickened, its outer coat thickly infiltrated with poly-

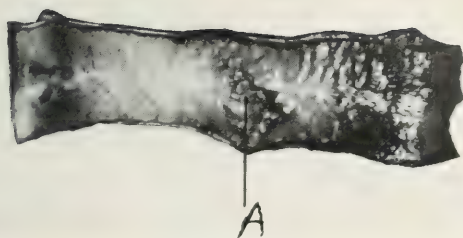
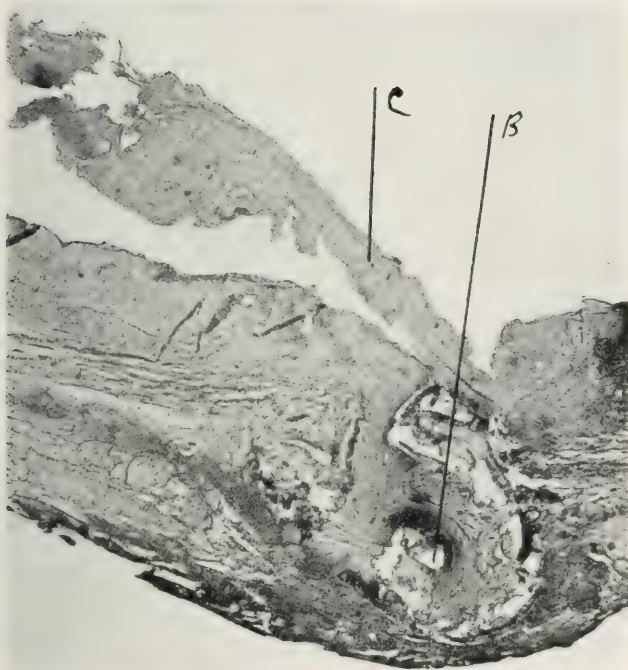


FIG. 6. CASE 2.—A, line of incision.



CASE 2.—B, remains of suture; C, small valvular thrombus.

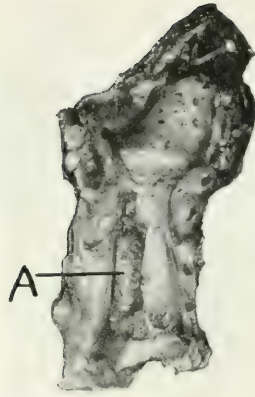
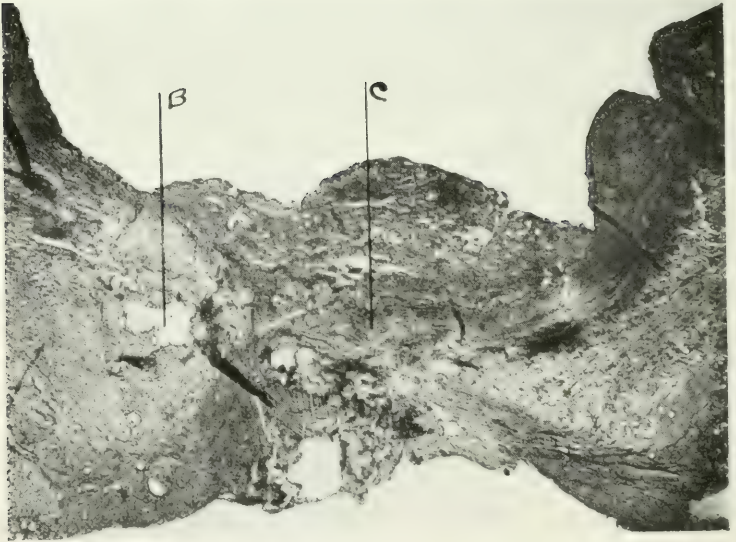


FIG. 7. CASE 3.—A, line of incision.



CASE 3.—B, remains of suture; C, line of healing.

nuclear leucocytes, a smaller degree of the same type also existing in the other coats (prominent in part of the intima). The tissues in the line of enclosure (compressed by the sutures) are dense, more or less hyaline and staining without definition, and irregularly electing the hæmatoxylin and eosin tints. These tissues do not show any leucocytic infiltration. Especially in the outer coat the lymph-spaces are distended and contain a fibrinous coagulate, in which are seen scattered leucocytes. The endothelium of these spaces is swollen and occasionally desquamated. Throughout the wall but little cellular proliferation is evident.

CASE III.—Dog; Irish setter. Condition was good. The anæsthetic was morphine hypodermatically and ether by inhalation. The abdomen was opened and the abdominal aorta exposed 5 cm. above the common iliac artery; the clamps were applied and a longitudinal incision 2.5 cm. long was made in the artery. Bleeding occurred from the lumbar branches of the aorta, which were clamped and ligated. The artery was sutured with difficulty on account of the depth of the wound and the bleeding of the small veins. After the clamps were removed, the artery could be seen pulsating. Twenty-four hours after the operation the dog was in a weak condition, but the pulse was equal in both femoral arteries. Forty-eight hours after the operation the pulse could be felt in the femoral arteries, but was very rapid and weak; suppurative peritonitis was apparently present. Ninety-six hours after the operation the pulse could be felt in the femoral arteries; peritonitis was present, and as the dog was suffering acutely he was killed by chloroform. Post-mortem findings: Suppurative peritonitis was present; the artery was removed and opened up; a slight lateral thrombus caused by an infected suture was found. (Fig. 7.)

Pathological Report.—Gross specimen, a short length of abdominal aorta with its bifurcation, preserved in a solution of formaldehyde, shows the vascular wall with surrounding tissue closely adherent, and with discoloration from hyperæmia persisting. Laid open, the general intima shows no gross change. Over the line of longitudinal incision is a slight ridge of thrombosis apparently but little changed. The walls of the vessel, especially a little away from the line of closure (which is the thinnest part of the circumference), are thickened, hyperæmic and apparently the seat of inflammatory infiltration, but without gross appearance indicating suppuration.

Microscopic.—Section made transversely, at right angles with the line of operative wound. Over the incision in the lumen of the vessel lies a fibrinous thrombus, showing no organization as yet, with a rich polynuclear leucocytic infiltration along its base, and containing numerous hæmatoxylin-stained fragments (fragments of leucocytic nuclei). The line of incision shows a distinct mass of polynuclear leucocytes extending from the base of the clot to the exterior of the vessel. Tissue along the line of closure of the wound shows embedded suture, and it is densely hyaline in character, electing the eosin stain, being evidently necrotic. The general wall of the artery is deeply congested, at places infiltrated with blood; shows marked proliferation of the connective tissue, and

contains numerous polynuclear leucocytes, the latter densely infiltrating portions of the adventitia.

CASE IV.—Medium-sized dog. The anæsthetic was morphine and ether. The carotid artery was found on the right side of the neck, and the clamps were applied. A longitudinal incision 1.7 cm. long was made in the artery. The artery was sutured in the usual manner, the clamps were removed and no hæmorrhage occurred. The superficial fascia was sutured around the line of approximation, and the wound closed with through-and-through sutures. Twenty-four hours after the operation the dog was up and about, the pulsation was apparently normal. Three days after the operation the pulsation was normal, but the wound was infected. Four days after the operation the pulsation in the carotid artery was normal; the wound suppurating. The dog was killed on the fourth day; the artery was removed and opened up and a lateral thrombus was found.

Pathological Report.—The section of this specimen unfortunately takes in only one margin of the injury, which is apparently not closely approximated. The whole vessel wall is diffusely involved in acute inflammatory changes, with fusion of the similarly-involved surrounding tissue to the adventitia, so that no sharp demarcation of the outer coat of the vessel exists. Inside the vessel a comparatively fresh thrombus exists, adhering along the line of the wound. These tissues close to the line of injury are necrosed, taking diffusely and with poor definition the eosin stain; they are more or less diffusely infiltrated with blood, and the seat of numerous hæmic granules. Throughout the thickness of the vessel along this line the tissues are the seat of considerable leucocytic infiltration, of infection of the vasa vasorum, and of numerous round and spindle-shaped embryonic connective-tissue cells. Examples of phagocytic leucocytes are not infrequent.

CASE V.—Black horse, aged 20. Condition was very poor. An incision 22. cm. long was made on the right side of the neck; the carotid artery was found and the clamps were applied. The artery was cut completely across and end-to-end anastomosis was performed. Some difficulty was encountered in holding the edges together on account of having only one assistant and the horse shaking with a fine tremor. The clamps were removed and no hæmorrhage occurred. The deep fascia was sutured around the line of approximation. Twenty-four hours after the operation the horse was up and about, the pulse was good, full and equal on both sides. Three days after the operation the pulse was equal and the wound suppurating. Five days after the operation the pulse was good, full and equal on both sides; the wound was suppurating profusely. The horse was killed and the wound opened up; the artery was removed and incised; the lumen was not decreased, and no thrombus was present. (Fig 8.)

Pathological Report.—Gross specimen, preserved in a solution of formaldehyde, consists of a short segment of the artery freed from the surrounding tissues, with walls of apparently normal thickness and texture. Laid open, near the site of operation the intima is slightly

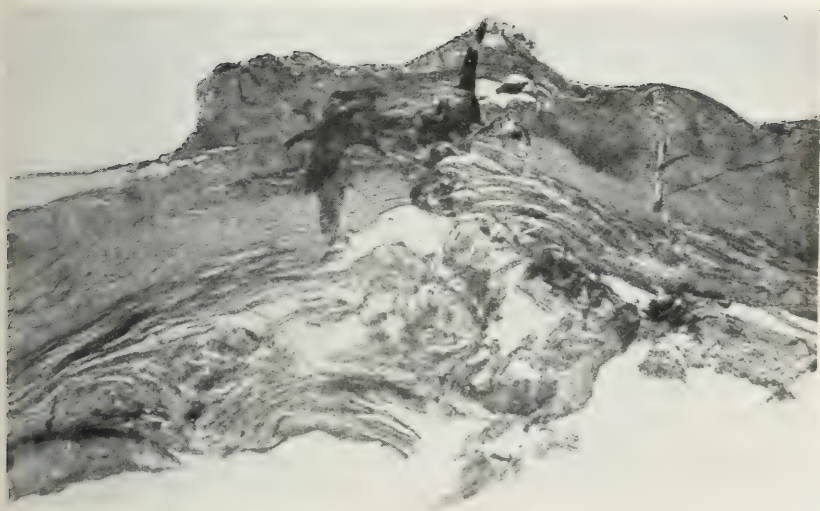
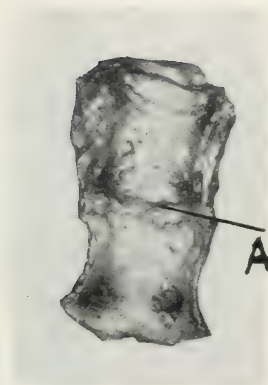


FIG. 8. CASE 5.—A, line of incision.

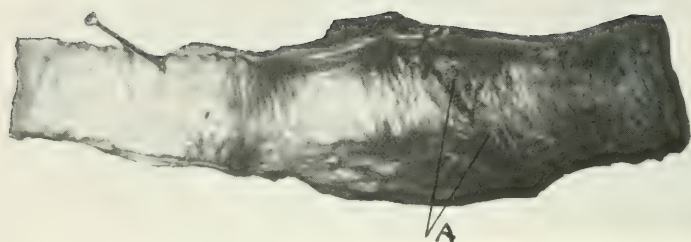
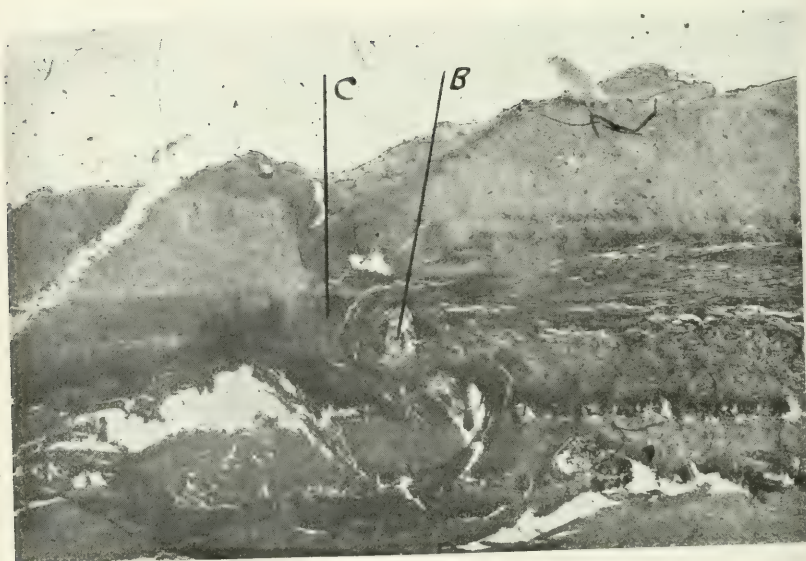


FIG. 9. CASE 6.—A, line of incision.



CASE 6.—B, remains of suture; C, line of healing.

nodular, apparently from slight focal swellings rather than from foci of thrombosis. The line of incision, a circular one, shows as a slight (circumferential) ridge a little less glistening than the adjacent intima, and presumably the seat of a small thrombus, which must, however, be partially organized. No distinct foci of softening from suppuration seen in gross inspection of the wall in section.

Microscopic.—Longitudinal section of artery (transverse to line of operative wound) shows a thin layer of granular clot over the site of wound; this clot is the seat of moderate leucocytic infiltration, especially toward the base (in clot numerous nuclear fragments probably from leucocytic disintegration). In one part of the clot evidence of beginning vascularization. On the outside of the vessel are several tiny foci of suppuration shown in the section, and in the inner muscular layer and intima is a similar infiltration somewhat more diffused. Little reparative activity evident, and the general wall remains thin, showing microscopically but little embryonic cell formation present in the layers. The tissue does not show a clear line of incision; an irregular fragmented part of the wall evidently represents the wound; and in this part there is a special tendency on the part of the tissues of the muscular coat to select the hæmatoxylin.

CASE VI.—Mouse-colored horse, aged 17. Condition was very poor. An incision 20. cm. long was made on the right side of the neck, the carotid artery was found and the clamps were applied. The artery was divided completely across and end-to-end anastomosis performed. The clamps were removed and no hæmorrhage occurred. The deep fascia was sutured around the line of approximation. The pulse was equal in both submaxillary arteries. Twenty-four hours after the operation the horse was up and about, the pulse was good, full and equal on both sides. Three days after the operation the pulse was equal on both sides and the wound suppurating. Five days after the operation the pulse was equal on both sides. Seven days after the operation the pulse was good, full and equal on both sides, and the wound was still suppurating profusely. The horse was then killed and the wound opened up; the artery was removed and incised; the lumen was not decreased and no thrombosis present. (Fig. 9.)

Pathological Report.—The gross specimen, preserved in a solution of formaldehyde, shows an artery with the surrounding tissues at the site of operation intimately adherent to the external part of the wall, and with traces of discoloration and hyperæmia. Laid open, the intima shows a circular, slightly depressed line of operative union, without clear evidence of thrombosis, but somewhat roughened as if from a small deposit of this type. The gross section of the wall presents just beneath the line of closure, which is apparently firm, a small focus of pale opaque appearance, its substance somewhat softer than the general tissue, and suggesting a point of suppuration about a suture. The tissue of the deeper part of the wall and the adjoining tissue have a succulent appearance suggesting inflammatory infiltration rather than dense fibrosis from complete healing.

Microscopic.—Section made longitudinally, transversely to line of

operation. There exists a small definite fibrous clot upon the intima just over the line of incision. The incision has been obliterated by partial healing, but the whole wall of the vessel is much thickened by an intense exudative inflammation. The outer wall is the seat of wide distension of its spaces which are filled by a fibrinous reticulum thickly beset with polynuclear and eosinophilic leucocytes, and at several points suppuration evidently is focalizing. The muscle-layers in both coats are separated and sharply outlined by a cellular infiltration particularly rich in eosinophilic cells, and the intima is much thickened, particularly by an embryonal cell infiltration, full of capillaries. Embedded in the tissue at the site of the wound is a suture about which is a marked suppurative infiltration, and in its vicinity there is more or less necrosis of the older tissue indicated by its hyaline appearance and strong election of the eosin stain. The suppuration only in a minor degree is invading the deeper part of the thickened intima, and is apparently a process implanted after healing had partially proceeded.

CASE VII.—Bay horse, aged 14. The diagnosis of thrombosis of the iliac arteries was made by Dr. John W. Adams. The horse was transferred to us through the kindness of Dr. Adams. The anæsthetic was chloral and chloroform. An incision 22. cm. long was made on the right side of the neck; the carotid artery was found and the clamps were applied. An oblique incision with ragged edges 2.5 cm. long was made in the artery. The artery was sutured, the clamps were removed and no hæmorrhage occurred. After the deep fascia was sutured around the line of approximation, the artery could be seen pulsating. The superficial wound was closed with through-and-through sutures. The pulse was equal on both sides. Twenty-four hours after the operation the pulse was good and equal on both sides; the horse was up and about. Three days after the operation the pulse was equal on both sides and the wound was suppurating. Five days after the operation the pulse was equal on both sides. Seven days after the operation the pulse was equal on both sides and the horse was in good condition. Nine days after the operation the pulse was good, full and equal on both sides; the wound was suppurating. The horse was killed and an autopsy was performed by Dr. C. Y. White. The thrombosis of the iliac arteries was found as diagnosed before operation. The incision in the neck was wide open and the artery could be felt in the bottom of the wound. The artery was removed, opened up and a slight lateral thrombus found, but the lumen was not decreased. (Fig. 10.)

Pathological Report.—Gross specimen, preserved in a solution of formaldehyde, consists of an artery with the surrounding tissue closely adhering to its outer part, and with traces of previous hyperæmia persisting. Laid open, a line of incision extending longitudinally is marked out by a thin, somewhat elevated and irregular thrombus, in places apparently partly organized, but at others still red and relatively unchanged. The general lumen of the vessel could not have been importantly impaired thereby. The intima in this part of the vessel is generally roughened, with nodules and slight ridges, which are apparently for the most part points of slight thrombus formation, and in part due to local thickenings

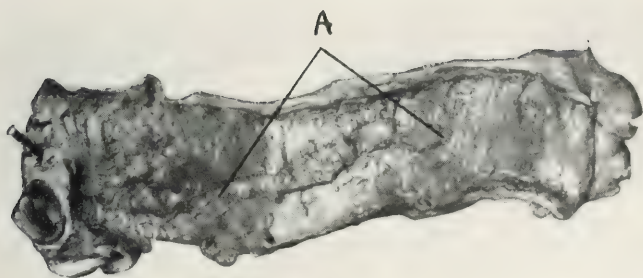
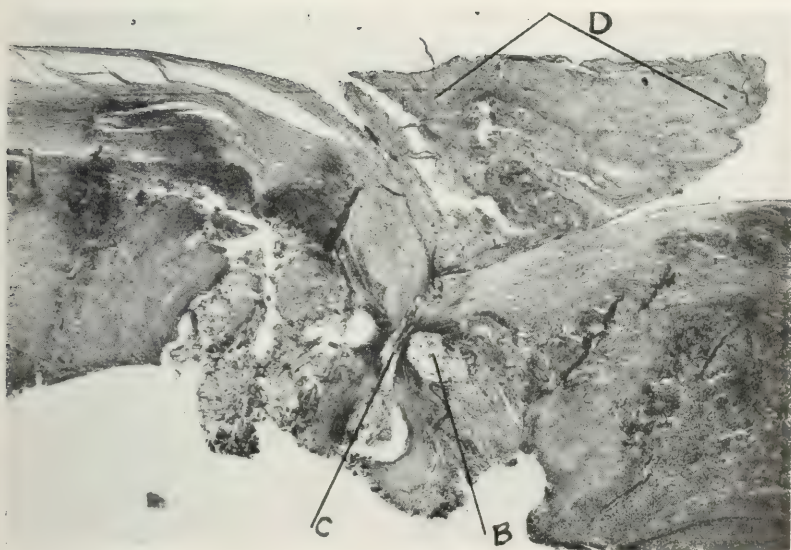


FIG. 10. CASE 7.—A, line of incision.



CASE 7.—B, remains of suture; C, line of healing; D, lateral thrombus.

of the intima. In cut section the thrombus is seen to be directly connected with the depression of linear closure of the arterial wound, and the intima generally seems redder than the deeper portions of the wall, the latter being, however, somewhat spongy and probably the seat of more or less inflammatory infiltration.

Microscopic.—Section made transversely to length of vessel, nearly transversely to the line of operative wound. Definite lateral thrombus overlying the line of wound shows no clear evidence of organization. Incision still to be traced through the whole thickness of the arterial wall; the tissues included within the sutures largely necrosed, hyaline, stained diffusely with the eosin of the hæmatoxylin and eosin preparation. From the borders of this hyaline part of the wall, marking the line of the wound adaptation, there extends diffusely through all the coats of the vessel a thick polynuclear leucocytic infiltration, in places (mainly media) rich in eosinophilic cells, with numerous endothelioid and embryonic connective-tissue cells interspersed. There is but little leucocytic infiltration in the clot, which, however, contains considerable hæmatoxylin-stained detritus, probably fragments of leucocytic nuclei.

CASE VIII.—Medium-sized dog. The anæsthetic was morphine hypodermatically and ether by inhalation. The carotid artery was found on the left side of the neck and the clamps were applied. An oblique incision 1.5 cm. long was made in the artery. The artery was sutured in the usual manner; the clamps were removed and no hæmorrhage occurred. The deep fascia was sutured around the line of approximation, and the wound closed with through-and-through sutures. Twenty-four hours after the operation the dog was up and about, and the artery was pulsating normally. Three days after the operation pulsation was apparently normal. His condition remained normal until he was killed, on the twelfth day. Post-mortem findings: The skin wound had united by first intention; the artery was removed and opened up; no thrombus was present, and the lumen was not decreased.

Pathological Report—Gross.—The artery is embedded in the surrounding tissues, which are closely adherent and are the seat of marked hyperæmia and inflammatory infiltration. Laid open, the vessel lumen is intact, the general intima smooth and glistening, and the line of incision marked by a small depressed linear scar.

Microscopically, there is marked hæmorrhagic infiltration in the surrounding tissues, together with numerous leucocytes and proliferated connective-tissue cells. No foci of suppuration. The whole wall of the vessel is the seat of numerous embryonic connective-tissue cells, mainly as fibroblasts. The line of incision is obliterated by a young scar. No appearance of thrombosis overlies this upon the intima, which is somewhat thickened and puckered at the site of the wound, but otherwise practically normal.

CASE IX.—Mongrel dog. The anæsthetic was morphine and ether. The carotid artery was found on the left side of the neck, and the clamps were applied. A longitudinal incision 1.5 cm. long was made in the artery. The artery was sutured in the usual manner; the clamps were

removed and no hæmorrhage occurred. The deep fascia was sutured around the line of approximation, and the wound closed with through-and-through sutures. Twenty-four hours after the operation the dog was up and about, the pulse being apparently normal. Three days after the operation the pulsation was normal, but the wound was infected. The animal was normal until he was killed, on the fourteenth day. Post-mortem report: The artery was immediately removed and opened up; a small lateral thrombus was present.

Pathological Report.—The artery contains a thrombus composed mainly of red cells and a granular fibrin, with at one place numerous polynuclear leucocytes penetrating the mass. No evidence of actual organization of thrombus; and no appearance, in sections examined, of endothelial or subendothelial proliferation in reaction to thrombus; the only changes of this type are along the line of wound of the artery-wall. In the latter line of incision, which is quite approximated and closed, the wall of the artery from without to the endothelial lining is the seat of a mass of well-formed fibroblasts, uniting the approximated surfaces; and close to the cut and over it the endothelium shows as a single (at few places double) line of pyriform cells projecting into the lumen of the vessel, but apparently quite free from the clot within. At one point, close to the cut in the adventitia, and upon the opposite side of the artery in the surrounding fat tissue, are minute foci of suppuration. Remnants of the sutures persist. Apparently in this case the healing of the wound and the thrombus are not synchronous processes; the latter is too fresh to date back to the origin of healing. Perhaps it is a thrombus occurring secondarily in connection with the suppuration which is evidently beginning in the arterial coat. The healing itself seems, even to the formation of an endothelial lining, to be progressing favorably.

CASE X.—Bay horse, aged 18. His condition was very poor. The anæsthetic was chloral and chloroform. An incision 22. cm. long was made on the right side of the neck; the carotid artery was found and the clamps were applied. One of the usual clamps was lost, and in its place a heavy hysterectomy forcep was used on the proximal end of the artery. The artery was divided completely across and circular end-to-end anastomosis performed. The clamps were removed and no hæmorrhage occurred. After the deep fascia was sutured around the line of approximation the artery could be seen pulsating. The wound was closed with through-and-through sutures. The pulse was equal on both sides. Twenty-four hours after the operation the horse was in good condition and the pulse equal on both sides. Three days after the operation the pulse was not as full or as strong on the operative side. The wound was suppurating. Four days after the operation the pulse was decidedly less on the operative side. Five days after the operation the pulse was very small on the operative side and the wound was still suppurating profusely. From the fifth to the fourteenth day the pulse gradually increased in volume and strength, but was not equal to the normal side at any time. The horse was killed on the fourteenth day by bleeding from the opposite side. The artery was removed and opened; a thrombus that almost filled

the artery was found, extending from the position of the heavy clamp down to the line of suture. Through a mistake of the attendant the horse was injected with formalin before the artery was removed. The thrombus was not of recent origin, so could not have been caused by the formalin.

Pathological Report.—The specimen examined grossly after preservation in a solution of formaldehyde shows an artery embedded in the surrounding tissues, and poorly defined from those about the level of operation. There is no evidence in the preserved specimen of any intense hyperæmia or hæmorrhagic infiltration of the tissues. Laid open, the vessel shows a dark, obstructing clot, which was slightly adherent along the line of operation, and which shows a more or less lamination on cross section. The line of incision is a circular one; it is somewhat puckered and overlaid by remnants of the clot, where the latter is torn off in the examination, and is superficially apparently firmly united. In section of the wall immediately beneath the slightly thickened intima at the site of closure are several points of softening apparently from suppuration and seemingly about the sutures. The general tissue at this site is soft and spongy, suggesting decided inflammatory infiltration.

Microscopic.—Section at site of operative lesion shows a thin, parietal granular (plaque) thrombus almost limited to the line of incision. The intima is thicker than normal near the lesion, but densely fibrous. Its endothelial coat is lost near the incision, and here its tissue stains with poor differentiation and strongly with the eosin of the hæmatoxylin-and-eosin preparation, giving the appearance of necrosis. Embedded beneath the intima is a loop of the suture used. This suture is surrounded by a dense infiltration of polynuclear leucocytes, and extending from this focus to the subendothelial portion of the intima on each side of the incision may be traced an infiltrating line of the same elements, along the border of the above necrosed part of the intima. The whole coat of the vessel is thickened, but definite suppuration is confined to the vicinity of the suture. The deeper coats are richly studded with round and spindle-shaped embryonic connective-tissue cells, with scattered leucocytes (numerous eosinophiles), and in the spaces of the adventitia the endothelium is swollen and often proliferated.

CASE XI.—Medium-sized dog. The anæsthetic was morphine hypodermically and ether by inhalation. The carotid artery was found on the left side of the neck, and the clamps were applied. A longitudinal incision 1.5 cm. long was made in the artery. The artery was sutured in the usual manner; the clamps were removed and no hæmorrhage occurred. The deep fascia was sutured around the line of approximation and the wound closed with through-and-through sutures. Twenty-four hours after the operation the dog was up and about; the pulsation in the carotid artery was apparently normal. The animal remained normal until he was killed, on the twenty-first day after the operation. The artery was removed and opened up, no thrombus or narrowing of the lumen being present. (Fig. 11.)

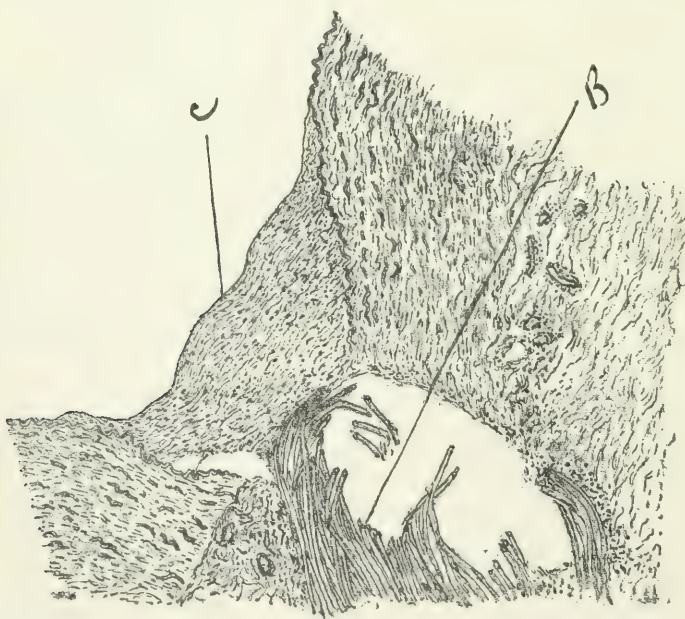
Pathological Report.—Transverse section at site of injury shows complete healing of the intima, with perfect endothelial line. Intima at this

point thickened, the thickening impinging upon the deeper tissues rather than protruding into the vascular lumen. Inner elastic lamina perfect beneath the subendothelial thickening. The thickened intima is for the most part fully fibrous, but strands of embryonic cells (fibroblasts) pass



FIG. 11. CASE 11.—A, line of incision.

into the mass along with capillary vessels. No evidence of thrombus on the intima. In the media there persist strands of the sutures with considerable young connective tissue intervening among the muscle-bundles.



CASE 11.—B, remains of suture ; C, line of wound completely healed.

Here the elastic layers are somewhat broken in their continuity, but are quite apparent and show no appreciable degenerative changes. About the sutures among the young connective-tissue cells a few foreign-body giant-

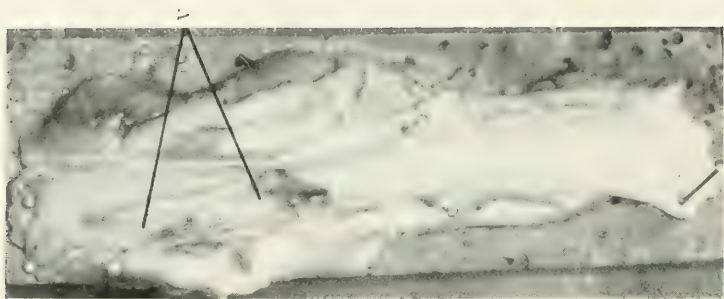
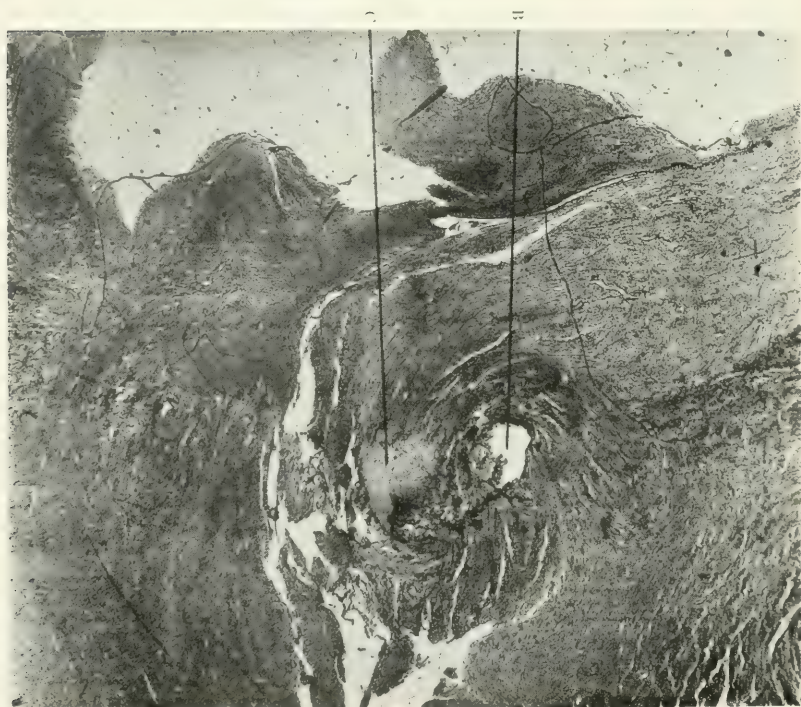


FIG. 12. CASE 12.—A, line of incision.



CASE 12.—B, remains of suture; C, line of healing.

cells are present. The adventitia presents practically the same features as just described in the media, and is slightly thickened from the fibrosis and young connective-tissue elements.

CASE XII.—Mouse-colored polo pony, aged 17. His condition was very poor. The anæsthetic was chloral and chloroform. An incision 22. cm. long was made on the right side of the neck; the carotid artery was exposed and the clamps were applied. A longitudinal incision 3.5 cm. long was made in the artery. The artery was sutured, the clamps were removed and no hæmorrhage occurred. The deep fascia was sutured around the line of approximation, and the superficial wound closed with through-and-through sutures. The pulse was equal on both sides. Twenty-four hours after the operation the horse was up and about, the pulse was equal on both sides. Three days after the operation the pulse was equal on both sides and the wound was suppurating. The pulse was equal on both sides until he was killed, on the twenty-first day. Post-mortem findings: The artery could be felt at the bottom of the wound. The artery was removed and opened up; the lumen was slightly decreased, but no thrombus was present. (Fig. 12.)

Pathological Report.—The gross specimen, preserved in a solution of formaldehyde, consists of an artery closely welded with the surrounding tissue, traces of well-marked hyperæmia being present in the latter in the neighborhood of the operative wound. Laid open, the lumen is seen to have been permeable; the intima is marked by a slightly-elevated longitudinal line of about 3.5 cm. in length, thus presenting the appearance of recent scar-tissue rather than of an unorganized clot. Its irregular outline suggests, however, that it represents an organized linear thrombus rather than a direct adhesion of the applied surfaces of the intima. Transverse section inspected grossly corresponds with the above idea, the linear scar above mentioned being distinctly elevated above the surrounding surface of the intima, and below it in the wall are seen tiny foci of a softer, opaque substance suggesting points of suppuration; the deeper parts of the vessel-wall and the immediately-surrounding structures have a somewhat spongy or succulent appearance, suggesting marked inflammatory infiltration.

Microscopic.—Transverse section of artery, at right angles to the line of operative incision, shows over the site of operative line a small partly-organized thrombus. The organization is more perfect along the lateral borders of the clot. At its base, close to the line of the incision, there begins a polynuclear infiltration which continues outward through the intima to become especially marked about an embedded suture. The tissue between two strands of this suture (evidently section of the loop) is necrotic, almost hyaline, and poorly staining. All the coats are thickened and studded with embryonic elements, scattered leucocytes (many eosinophiles especially near the line of suppuration), and endothelioid cells (proliferated endothelium of lymph spaces). In several foci presumably near a suture giant cells are found in greater or smaller numbers. The general appearance here suggests that the clot was of earlier occurrence than the suppuration, and that the latter process is penetrating into the partly-healed wound.

CASE XIII.—White horse, aged 20. The anæsthetic was chloral and chloroform. An incision 22. cm. long was made on the right side of the neck; the carotid artery was exposed and the clamps were applied. A longitudinal incision 3.7 cm. long was made in the artery. The artery was sutured, the clamps were removed and no hæmorrhage occurred. The deep fascia was sutured around the line of approximation and the superficial wound closed with through-and-through sutures. The pulse was equal on both sides. Twenty-four hours after the operation the horse was up and in good condition, the pulse being equal on both sides. Three days after the operation the pulse was equal on both sides; the wound was suppurating. The pulse was equal on both sides until the horse died, from a small secondary hæmorrhage, on the thirty-third day. The artery was removed from the wound and examined. It opened into a pus sac which completely surrounded the artery; the lumen was not decreased, and no thrombus was present. It did not seem possible the horse could have died from the small secondary hæmorrhage, but no other cause could be found. (Fig. 13.)

Pathological Report.—The artery contains a thrombus composed mainly of red cells and a granular fibrin, with at one place numerous polynuclear leucocytes penetrating the mass. No evidence of actual organization of thrombus; and no appearance in sections examined of endothelial or subendothelial proliferation in reaction to the thrombus; the only changes of this type are along the line of wound of the arterial wall. In the latter line of incision, which is quite approximated and closed, the wall of the artery from without to the endothelial lining is the seat of a mass of well-formed fibroblasts uniting the approximated surfaces, and close to the cut and over it the endothelium shows as a single line of pyriform cells projecting into the lumen of the vessel, but apparently quite free from the clot within. At one point, close to the cut in the adventitia and upon the opposite side of the artery in the surrounding fat-tissue, are minute foci of suppuration. Remnants of the sutures persist. Apparently in this case the thrombus is too fresh to date back to the origin of healing. Perhaps it is a thrombus occurring secondarily in connection with the suppuration which is evidently beginning in the arterial coat. The healing itself seems, even to the formation of an endothelial lining, to be progressing favorably.

CASE XIV.—Sorrel horse, aged 18. The anæsthetic was chloral and chloroform. An incision 22. cm. long was made in the right side of the neck; the carotid artery was exposed and the clamps were applied. The artery was divided transversely two-thirds the way through and then sutured, the clamps were removed and no hæmorrhage occurred. Some difficulty was encountered in suturing because of a very fine tremor. The deep fascia was sutured around the line of approximation, and the superficial wound closed with through-and-through sutures. The pulse was equal on both sides and the horse was in good condition. Twenty-four hours after the operation the pulse was equal on both sides. Three days after the operation the pulse was equal on both sides and the wound was infected. The pulse were equal until the tenth day, when the pulse on the

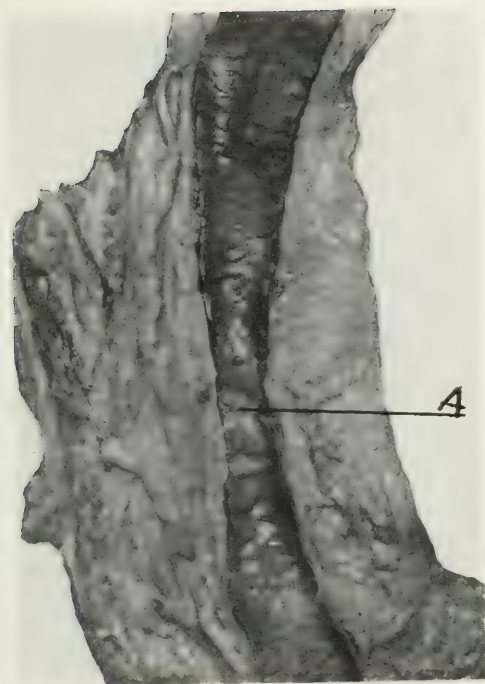
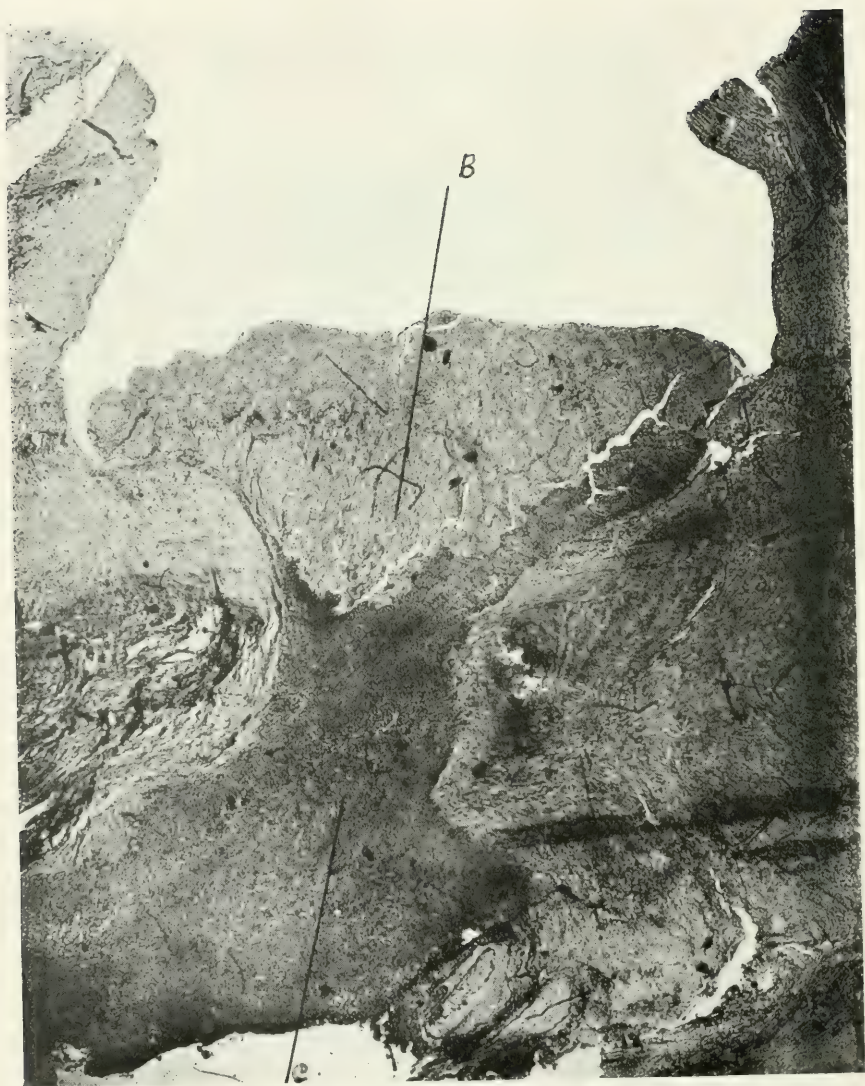


FIG. 13. CASE 13.—A, line of incision.



CASE 13.—B, lateral thrombus; C, pus.

operative side was slightly less. The wound was suppurating profusely. From the tenth until the eighteenth day the pulse was decidedly less on the operative side. From the eighteenth day until the forty-second day the pulse gradually increased in volume, but was not equal to the opposite artery at any time. The horse was killed on the forty-second day. The wound was suppurating profusely. The artery was removed and opened up. Complete thrombosis was found. In dissecting out the artery the vein was found very much thickened.

Pathological Report. Gross Specimen.—Two lengths of the vessel, preserved in a solution of formaldehyde, are presented for examination; both are the seat of occluding thrombosis; the thrombi are dark in the central part and paler and more or less organized and adherent to the intima along the periphery. The general wall of the artery is thickened, pale and dense from sclerosis. No appearance of suppurative softening on gross inspection.

Microscopic.—A section made transversely to the length of the vessel contains a large thrombus with organization proceeding, the greater part of the clot being well cellularized. Phagocytic leucocytes are numerous in the interior of the clot. No evidence of suppuration present. Distinct extension of fibroblasts and young vessels from the intima. The general coat of the vessel shows no evidence of suppuration; the blood-vessels are slightly injected, their coats are unusually thick; but little embryonic cell-formation is evident; when seen it mainly exists about the vasa vasorum, in the adventitia, and between the muscle-bundles of the media.

There were fourteen operations in all—nine on horses and five on dogs. The experiments on the nine horses and one dog were performed at the Veterinary Hospital of the University of Pennsylvania. The operations on the remaining four dogs were performed in the surgical operating-room of the medical laboratory. All the cases operated on at the Veterinary Hospital suppurated, and half of those at the laboratory. The operations on the horses were three complete circular, two transverse, three longitudinal and one oblique; on the dogs, four longitudinal and one oblique. When the arteries were opened up, in seven no thrombus was visible, in five a slight lateral thrombus was present; in one case we used a heavy hysterectomy forcep instead of our special clamp (clamp lost in transporting instruments), and almost complete thrombosis was present from the position of the clamp to the line of suture; in another case complete thrombosis occurred from infection around the artery. One ruptured on the thirty-third

day into a pus-sac surrounding the artery, but no thrombus was present.

Conclusions.—1. Only one secondary hæmorrhage occurred, and that one was directly traceable by microscopical examination to infection from without; this alone is a distinct advantage over the older methods. 2, Under the aseptic conditions employed in human surgery the results ought to be perfect, as our thrombosis can almost always be traced to infection. 3, Whatever suture used, the principle of placing the intima to intima is absolutely essential. 4. The suture must be kept out of the blood-stream.

In closing I wish to acknowledge my indebtedness to Dr. De Forest Willard for his many valuable suggestions and for the financial aid which made it possible to perform these experiments, and to Dr Allen J. Smith for the pathological reports. I also wish to thank the staff of the Veterinary Hospital for their many courtesies and Dr. Barnett, Resident Physician, in particular, for valuable assistance in many ways and for untiring efforts in my behalf; Mr. H. S. Hutchinson and Mr. F. Beekman, of the third-year medical class, for their assistance.

COMBINED SUPERIOR TIBIOFIBULAR AND AS-
TRAGALOFIBULAR OSTEOPLASTY AS A
MEANS TO PREVENT SHORTENING OF THE
LEG AFTER EXTENSIVE OSTEOMYELITIS OF
THE TIBIA OCCURRING DURING ADOLES-
CENCE.¹

BY NORMAN KERR, M.D., C.M.,

OF CHICAGO.

ACUTE inflammatory lesions of bone under the term of Necrosis, have commanded the most serious attention of the medical profession since the earliest history of medicine, and it was Chassaignac in 1854 who first applied the term "osteomyelitis" to that suppurative affection of bones, which is of so-called idiopathic origin.

It may be interesting to us as Americans to note that this disease was minutely described by Nathan Smith in 1829. The case was that of a colored boy eleven years of age, who was admitted to the Baltimore Infirmary for the treatment of disease of the thigh. To any one who may be interested, a full description of this case is given on page 121 in his "Medical and Surgical Memoirs."

Early diagnosis followed by prompt and thorough evacuation of the infected area by a sufficiently long incision of the soft parts, including the periosteum, combined with free opening of the medullary canal is regarded by the profession the proper procedure to carry out, but it is in the later stages that considerable difference of opinion exists in the minds of progressive surgeons.

Some advise the expectant plan after free drainage is established because they fear that the periosteum may not be able to generate new bone; others depend on this membrane with an abiding faith, and it is quite remarkable to note that those

¹ Read before the Chicago Surgical Society, April 6, 1906.

belonging to the former class assign no reason why it does not do so.

Nichols, with what might be called a wise diplomacy, supported by an extensive knowledge gained from his experimental work, takes a somewhat middle course and advises waiting until the periosteum demonstrates its ability to reproduce new bone by the appearance of osteoblasts on this membrane; then he advises the radical removal of the shaft and epiphysis if necessary, and thorough antiseptic cleansing of the infected parts, after which the periosteum is sutured and the cavity obliterated. His work constitutes a considerable advance in the treatment of this very serious disease, and the time that is usually the most favorable in his opinion for the removal of the shaft is from the eighth to the tenth week after the onset of the disease.

The results obtained by Cushing and others in Boston certainly seem to warrant the assumption that the above procedure is a marked improvement over the older methods of delay.

Reverting to the early treatment, Nichols advises that the endosteum be not disturbed as is so often done by the curetting of the bone-marrow. His conclusions are:

a. Drainage of the soft parts is not sufficient; the bone-marrow is often infected and must be drained.

b. A portion of the cortical bone must be removed by the trephine.

c. Curetting of the bone-marrow should not be done, as it causes extensive destruction of the endosteum.

d. Operate as early as possible.

e. In the subacute stages, remove the necrotic shaft completely or partially at an early stage; for mechanical reasons the manipulation of the periosteum is easier after ossification of the periosteum has begun, but while the membrane is still plastic, and the rapidity and surety of perfect regeneration seem greater at that time.

f. Early performance of an operation and removal as far as possible of all infected areas lead to an earlier success.

Berndt is one of those who never has any fear that the

periosteum will not generate new bone, while Küster claims that failure sometimes occurs.

The question of the ability of the periosteum to generate new bone is very important, because in many cases this takes place so rapidly that great shortening of the limb is prevented, particularly in those patients who are nearing the end of the period of adolescence, also in those in whom the epiphyseal line is not destroyed by the disease.

Von Bergman clearly draws attention to the fact that if the disease, in cases in which the tibia is involved, is only of sufficient activity to stimulate the epiphyseal line, lengthening of the bone takes place and a position of valgus occurs; but if the line is destroyed, in whole or only partially, shortening results in a position of inversion of the foot.

There are cases on record, particularly of severe traumatism to the tibia, in which the shortening was so great that the patient had to bear the weight of the body on the outer malleolus in some cases, and in others had to contend with the disability incident to the upward displacement of the fibula on account of this bone occupying a position external to the knee-joint.

A review of the literature on the subject of osteomyelitis, while it brings out many interesting and practical points, fails to inform us what percentage of cases have their origin in the upper and lower ends of the tibia respectively; but it is probable, inasmuch as the lower end of the femur is the area most frequently involved of all the bones, that the upper end of the tibia is attacked oftener than the lower, because the growth in the upper portion is estimated to be about three-fourths of the whole, while the lower is one-fourth.

The experience gained from the following case seems to the writer to warrant the conclusions: That the periosteum can be relied upon to regenerate new bone; that it is not necessary to wait for two or two-and-a-half months for evidences of repair on the part of this membrane, and that it is even better to remove the shaft of the tibia entirely just as soon as one feels satisfied that the vitality of the involved bone is sacrificed;

that on account of the difficulties of rendering the parts sufficiently aseptic, through-and-through drainage either with gauze or tubes should be instituted just preliminary to the suturing of the edges of the periosteum together.

The principal point in this case and the one which the writer believes to be of value in properly selected cases, is the substitution of the fibula for the tibia as the pressure-bearing bone, in order that continued growth in the length of the leg may be maintained.

The time since the operation is entirely too short to prove absolutely whether the fibula will continue to grow in length as fast as its fellow, but the writer believes it will. Another advantage of this line of treatment, properly carried out, is the great saving of time, because as soon as suppuration has ceased the double osteoplasty, described later, can be performed and the patient allowed to walk as soon as he can after being treated for a compound fracture, say six or eight weeks.

The procedure suggested is as follows,—which, however, was not carried out in this case, because only one osteoplasty was done at a sitting, whereas both should have been performed on the same day and much time saved:

First. Remove all the infected bone and suture the edges of the periosteum together, except at the ends, and drain sufficiently; at the same time prevent deformity as much as possible by the use of splint or cast.

Second. After suppuration has ceased, destroy the upper tibiofibular joint and cause ankylosis at this point; also divide the lower end of the fibula on a level with the upper surface of the lower epiphysis if this is not destroyed, or the astragalus if the epiphysis of the tibia has been sacrificed to the disease, and place the end of the fibula on the new location, either the lower epiphysis of the tibia or the astragalus.

The case report is as follows:

Francis D., aged 10. Had scarlet fever and diphtheria several years ago. Father living and in good health. Mother died of tuberculosis two years ago. Present illness: September

26, 1905, he fell and hurt his left leg near the ankle; three days afterward he went to bed, and a physician was called on October 2d, who, about a week later, made several short incisions and evacuated a large amount of pus. On October 21st he was admitted to the Children's Memorial Hospital suffering from great pain in the leg, which was flexed to a right angle with the thigh, and entirely functionless. Denuded bone could be detected to a great extent with a probe. Hot moist antiseptic dressings were ordered, to be changed every eight hours, and on October 24th a free incision was made over the tibia and the shaft found bathed in pus with the periosteum attached in a thin line on the posterior surface only. The entire diaphysis, lower epiphysis, and the upper portion of the astragalus, were removed down as far as the lateral articular surfaces extended.

After thorough irrigation, the space occupied by the removed bone was filled with iodoform gauze and the periosteum sutured over it, the gauze projecting at the upper and lower extremity of the incision.

A plaster-of-paris cast was applied from the upper part of the thigh to and including the foot. In two days the anterior portion of the cast was cut away, but enough was left about the foot, it was thought, to prevent deformity.

The gauze was removed and tubular drainage substituted, after which moist dressings were kept up until November 30th, then dry dressings until December 12th, when the condition of the leg seemed to warrant the safety of further operation without the danger of reinfection.

The foot by this time was markedly inverted and the following procedure carried out: An inverted U-shaped incision was made, commencing in front of the lower end of the fibula, passing up in front of this bone about four inches, then across and down almost to the level of the starting point, but behind the fibula. The flap thus outlined was turned down of all the soft parts over the bone, including a strip of periosteum about one-third of an inch, with the hope that it would form a sort of brace, and add strength to the leg subsequently. An examination of the last skiagraph taken shows that this hope has been partly realized.

The fibula was now divided with a chisel, on a level with the upper surface of the remaining portion of the astragalus,

and displaced inward until the foot assumed a marked everted position and the end of the fibula rested on the astragalus.

Before this operation the measurement from the lower edge of the right patella to the tip of the external malleolus was 32 cm., whereas the corresponding measurement on the left leg was 30 cm. The patient was allowed to walk about the middle of January, 1906.

On February 1st the measurement from a board touching both heels to right anterior superior spine of the ilium was $29\frac{1}{2}$ inches, or 75 cm., while the left was $28\frac{3}{4}$ inches, or 73 cm., and the distance from the top of the left fibula to the top of the tibia was one cm. less than that on the right leg, thus showing already a slight displacement upward of the fibula.

There was also considerable more motion about this joint than the right, consequently it was considered necessary to destroy it and produce fixation at this point in order to prevent further displacement upward.

On February 2d the boy was again anæsthetized and an incision anterior to the joint made; the articular surfaces were chiseled away; a depression was chiseled into the tibia about two cm. anterior to the normal location of the head of the fibula and the head forced into it, where it was held in place by a heavy kangaroo-tendon suture, carried through the head of the tibia and around that of the fibula.

The skiagraphs show the irregularity of the new tibia and its medullary canal, also the formation of a support from the tip of the fibula to the shaft, which has been thrown out by the periosteum, detached for that purpose.

THE RELATION OF THE TECHNIQUE OF NURSES AND OF HOSPITAL APPARATUS TO THE HEAL- ING OF WOUNDS.

BY CHARLES P. NOBLE, M.D.,

OF PHILADELPHIA,

Surgeon-in-Chief to the Kensington Hospital for Women.

It is the general belief of surgeons that infection in wounds, almost without exception, occurs in the operating-room as a result of introducing pathogenic microorganisms into wounds upon the hands of the surgeon or his assistants, or by means of the instruments or suture material or dressings employed. This belief has become general since the older theory that germs usually come in contact with wounds by means of the air was disproved. This source of contagion is believed to be a possibility, but practically to play a very small role in infection. This belief was held by myself and served as the practical basis of my own work until from experience I became convinced that the theory was not sufficiently broad to cover all the facts in hospital practice.

Some time ago, having occasion to investigate a series of infections occurring in clean wounds, I was driven to the conclusion that the infections did not occur in the operating-room, and upon careful investigation was satisfied that they were due to errors in technique on the part of the nurses, either before or after the patients had been operated upon. This experience led me to study the question of the technique of nurses and of the apparatus supplied to nurses in hospitals with which to perform their duties. It also led me to consider the wisdom of the plan usually followed by surgeons, including myself, of giving verbal orders to the head nurse in charge, and depending upon her to maintain a proper technique on the part of the pupil nurses.

¹ Read before the Philadelphia Academy of Surgery, May 7, 1906.

In this particular investigation I learned that the technique in use was quite different from what I believed it to be. Verbal orders had been given for many years, modified by other verbal orders from time to time, so that it was not surprising that the result of such a method should be a lack of exactitude in detail in carrying out general principles.

As a result of this experience I determined to adopt a technique which should be printed, so that there could be no question upon the part of the head nurse as to what was required, and no possibility on the part of any pupil nurse of misunderstanding the instruction of the head nurse.

With the assistance of the hospital staff a technique was compiled which was submitted to various head nurses for suggestions, and was used for a year so that it might be corrected by practical experience before being printed and finally adopted.

The result of this experiment, which I believe is novel, has been most satisfactory to all concerned. The long-continued series of infections which led to the investigation was promptly cut short and for nearly a year primary union was obtained, without exception, in non-suppurative cases.

During this particular series of infections already referred to, the same operating-room technique was employed which had been in use for a long time, with the result of obtaining primary union without suppuration in 98 per cent. of cases. When the infections began to occur, it was naturally supposed that this was due to carelessness on the part of some one connected with the operating-room. The personnel was gone over, every one was stimulated to rigid care in every detail of asepsis, with no improvement in the results secured. The sterilizing apparatus connected with the operating-room was overhauled and put in perfect order, and the time devoted to the sterilization of instruments, dressings, etc., and the disinfection of the hands was doubled, without result. Also the preparation of the field of operation was made more rigidly. These facts led me to consider whether it was possible for the wounds to become infected elsewhere. A peculiarity of the series of infections was that as a rule they were mild. The

mortality during the series, which extended over a number of months, was not increased. There were no cases of peritonitis in a long series of abdominal sections, and the infections as a rule occurred late and were confined chiefly to the subcutaneous fat. Finally, not only celiotomy wounds, but those of Alexander operations, hernias and eventually plastic operations upon the uterovaginal canal likewise became infected.*

Upon investigating the technique in use in the wards of the hospital I found evidence that the hands of the nurses were not adequately disinfected, that the douche bags were not sterilized, sterilization being limited to the douche-nozzle; that the basins and trays employed were not systematically sterilized (dependence being placed upon the solutions they contained for their sterilization), and that the methods in use for sterilization were far from satisfactory; also that the bath-tubs, while clean in the domestic sense, were not disinfected. It seemed to me to be a rational conclusion that patients being admitted to the hospital and given two or three baths in a bath-tub presumably septic, before being operated upon, and being prepared for operation by the hands of nurses which were not sufficiently disinfected, enough pathogenic microorganisms became implanted upon the skin of the patients to explain the series of infections. In order that this theory should be tenable it was, of course, necessary that the bath-tubs and the apparatus used by the nurses should have been infected from some patient early in the series of infections. In order to test the matter, rigid regulations as to the sterilization of all the apparatus used by the nurses, the disinfection of the bath-tubs and of the nurses' hands, were at once instituted and the usual technique of sterilization formerly in use in the operating-room was reverted to; that is, the amount of sterilization in the operating-room was cut down one-half. The result was

* During the time that the infections were occurring in the hospital, the same assistants, dressings and suture material were used repeatedly in operations elsewhere without infection occurring in wounds. It was this fact which finally induced me to look elsewhere than in the operating-room for the source of the difficulty.

immediate. The infections disappeared and the series was at an end.

It seems to me that the demonstration was complete that this series of infections came about in the way suggested. It has long been known that it is impossible to sterilize a surgeon's hands infected with virulent microorganisms by any means at our command, without a period of two or three days having elapsed since the infection took place. As a concrete example of this fact, in the early days, probably every abdominal surgeon had the experience of performing a celiotomy within one or two days after having examined a woman suffering from puerperal septicæmia, or having operated upon an abscess containing streptococci and of having the unhappy experience of seeing his patient contract a virulent septic peritonitis, with a fatal termination. The conditions were entirely similar in principle. The skin of the patient was infected with pyogenic microorganisms from the bath-tub or the nurse's hands, and the subsequent efforts at disinfecting the field of operation within the next day or two days were insufficient to render the field entirely sterile. The number of germs introduced in any case was insufficient to cause a fatal peritonitis, but did bring about suppuration in the wounds.

It seems to me that this demonstration is of sufficient importance to bring it to the attention of surgeons who, in general, like myself, have been convinced that to prevent suppuration in wounds it is only necessary to maintain a rigid technique in the operating-room.

Being convinced of the facts in the case, I investigated the nature of the apparatus in use by the nurses and the facilities afforded them to sterilize the same efficiently, and also the facilities afforded them for disinfecting their hands, when it became evident that these facilities were by no means adequate to obtain the best results. I therefore determined to institute a radical change. The problem was to eliminate all apparatus which could not be sterilized by boiling, to provide proper sterilizers by means of which all apparatus could be sterilized, and to study the problem of how the hands of the nurses could

be kept from contact with infected objects, and, in addition to this, to prescribe rigid regulations for the disinfection of the hands of the nurses. It required but little study to determine that, as hospitals are usually conducted, the hands of the nurses are constantly coming in contact with infected objects; for example, bed-pans are constantly receiving infected dejecta from the bowels, douche-pans are constantly receiving infected discharges from the genitalia, pus-basins and vomit-trays likewise are constantly handled by nurses, and the provision for the systematic sterilization of these utensils is lamentably poor or entirely absent. It was at once clear that if the hands of the nurses are to be kept free from contact with septic objects all such apparatus must be systematically sterilized.

It was clear also that under the usual conditions obtaining in hospitals all the objects about the wards with which the hands of the nurses come in contact might prove sources of infection, and that all such objects must be systematically disinfected.

A sterilizing plant was installed in the bath-room upon each floor sufficiently large to contain a dozen bed-pans or douche-pans. By means of high-pressure steam these can readily be sterilized by boiling. A rule was adopted that all bed-pans and douche-pans should be sterilized once daily, and thereafter stored in a clean closet until used. After use they are washed out in the usual way and drained. This prevents the carrying over of infection from one day to another. It would, of course, be more ideal if they were sterilized each time after use, but this was deemed to be an unnecessary nicety in practice. The point was to prevent carrying over infection from time to time or from one case to another. In addition to this, the customary rule that the apparatus in use upon septic patients should be isolated, was, of course, continued. A sterilizer similar to that used in operating-rooms for the sterilization of instruments was installed in each diet-kitchen, so that all of the basins and trays, catheters and instruments used by nurses can be sterilized as efficiently as is done in the operating room.

A rule was adopted that all basins, pitchers and trays used by nurses shall be cleaned and boiled for ten minutes after use, and then stored in formaldehyde solution 1-4000; also that this solution shall be changed daily. All bowls for solutions must be again boiled before using. A general rule was adopted that all apparatus used by nurses must be sterilized at least once daily.

A definite technique for the disinfection of the nurses' hands was adopted, as follows: The hands shall be scrubbed for three minutes with soap and water and a sterile nail-brush. The finger-nails shall then be cleaned with a sterile wooden nail-cleaner, and the hands shall be scrubbed again for three more minutes. The hands shall then be soaked in formaldehyde solution 1-500 or bichloride of mercury solution 1-1000, for two minutes.

As a further precaution against the possibility of infecting the skin of patients admitted to the hospital, in addition to preparing for the disinfection of the bath-tubs and the nurses' hands, a plan was adopted of having all patients prepared for operation during a certain period by a nurse assigned for that duty, called the preparing nurse, whose hands are thus kept from contact with septic material.

In applying the general principle of keeping the hands of the nurses free from septic material there were numerous details to be worked out, some of which have been met as follows: It is required that, after the usual daily cleaning by the ward maid, the door-knobs, window-sills, tables, chairs, bureaus, bedsteads, poles for douche-bags, and the tops of all furniture or objects in the wards or rooms, shall be wiped off with formaldehyde solution 1-500 by the nurse; also, that all shelving in the diet-kitchens and in the rooms in which the apparatus for nurses is kept, shall be washed daily; on alternate days with soap and water, and with formaldehyde solution 1-500.

Among other objects with which the hands of the nurses come in daily contact there are probably none which are more septic, if not absolutely dirty, as hospitals are usually con-

ducted, than the rubber sheets which are used to protect mattresses. The usual method of caring for these is to wipe them off when the patient is discharged and then to put them on another bed; and it is quite probable that even this wiping off process is often omitted. As these sheets necessarily receive discharges from the bowels, from the vagina, and from discharging wounds in many cases, from the necessities of the situation they must always be covered with pathogenic micro-organisms and are, therefore, a fruitful source of infection of the hands of nurses.

Such rubber sheets are treated by washing them thoroughly after use, after which they are soaked in formaldehyde solution 1-500 for twelve hours, wiped dry and put away in a sterile cloth, rolled on a roller, until used again.

The vomit-trays and pus-basins were eliminated as sources of infection of the nurses' hands by classing them with the other basins and trays in use, and having them cleaned and sterilized and stored in formaldehyde solution each time after use.

Another source of infection of the nurses' hands are the cans which are used to receive the dressings and waste from the wards. Such cans are in constant use in all hospitals, and receiving, as they do, septic dressings, they are a prolific source of infection of the nurses' hands. This source of infection was eliminated by requiring that the lids of the cans should be permanently removed, so that it is unnecessary for the nurse to touch the cans. When the cans are taken to the engine-room in order that their contents may be burned, they are cleaned, and then boiled in an apparatus installed for the purpose. This is done by the engineer force, and it requires but a few minutes when the apparatus is installed; and it eliminates one source of filth and infection with a minimum expenditure of time and effort.

In the operating-room some additional apparatus was installed to insure the absolute daily disinfection of every article in use in the operating-room. With the modern pressure-steam dressing-sterilizer and instrument-sterilizer there is no longer

any difficulty in adequately sterilizing dressings, instruments, towels, gowns, etc., but for convenience a large instrument-sterilizer similar to the ones designed for the sterilization of bed-pans, douche-pans, etc., was installed in the sterilizing-room, which will contain a sufficient number of basins, pitchers, etc., to furnish sterilized basins for a day's work.

A new apparatus was installed by means of which the hands of the surgeon and his assistants are washed in a spray of running water—the supply of water being controlled without using the hands. This apparatus eliminates the possibility of infecting the hands by washing them in septic basins.

In my judgment every hospital should install a plant which will sterilize its entire water-supply. Hospitals having a high-pressure steam plant can do this with very little expense by having the cold-water inlet-pipe pass through a cylinder sufficiently filled with copper tubes connected with the high-pressure steam plant to boil and sterilize the water on its way to the storage-tank. By regulating the size of this tank and the amount of heating surface in the copper coils to the daily amount of water used, it is a relatively simple mechanical problem to sterilize the entire supply of a hospital. An additional apparatus would be required to cool this water on its way to the storage-tank. Such an arrangement would not only assist in eliminating typhoid fever from hospitals, but would also be of material service in carrying out the principles of asepsis.

The plan so often followed in operating-rooms of using the same basins for several consecutive operations, merely washing them out between the operations, is reprehensible, and with the present facilities for sterilizing such apparatus there is no excuse for this bad custom.

The real difficulty in the sterilization of the apparatus in the operating-room was how to sterilize the irrigators, the slop-buckets, the Kelly rubber cushions, perineal pads, etc. This problem was satisfactorily solved with the assistance of a mechanical engineer. The largest slop-can, with the smaller put within it, is filled with water and by means of a metallic

connection with a high-pressure steam-pipe, live steam is turned into the water and the entire apparatus is sterilized by boiling. The Kelly pads are sterilized by soaking them over-night in formaldehyde solution 1-500, after thoroughly cleansing them. The problem of how to deal with irrigators was solved by using large rubber douche-bags, which are boiled each day before being used.

The points to which I would direct attention are:

1. Whether surgeons should be satisfied with the policy of giving verbal directions to head nurses about the disinfection of hospital apparatus and the technique of nurses as applied to the treatment of wounds; or, whether each hospital should adopt a routine technique which should prescribe the methods which are to be followed, thus avoiding any possibility of error on the part of the head nurse and pupil nurses.
2. The importance of preventing the infection of the hands of nurses by the elimination of all possible sources of contamination, through proper regulations as to the cleansing and disinfection of wards, rooms, furniture and apparatus employed by the nurses.
3. The adoption of a proper technique for the disinfection of nurses' hands.
4. The installation of proper sterilizers, which will enable nurses to sterilize the apparatus used by them as efficiently as is done in operating-rooms at the present time.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, April 25, 1906.

The President, DR. GEORGE WOOLSEY, in the Chair.

REMOTE RESULTS OF OPERATION FOR THE RADICAL CURE OF INGUINAL HERNIA.

DR. WILLIAM B. COLEY presented a young man upon whom he had operated fourteen years ago, by the Bassini method, for a left inguinal hernia which had existed since infancy. The hernia had been temporarily cured by a truss, but had relapsed. The operation had effected a perfect cure, and there were no indications of a recurrence at the present time. The operation had produced no effect upon the development of the testis. The patient was now married, and the father of two healthy children.

DR. JOHN B. WALKER presented a man upon whom he had operated ten years ago for a congenital left-sided inguinal hernia. There were no evidences of a recurrence up to the present time, but the patient had returned to be relieved of a hernia on the opposite side, which had recently developed as the result of a strain.

CARCINOMA OF THE MALE BREAST.

DR. WILLIAM B. COLEY presented a man, 64 years old, with a carcinoma of the left breast. The case was shown on account of the comparative rarity of this condition in the male, and because of the fact that it had existed for ten years, an unusually long period. The lesion was of traumatic origin, coming on two months after a blow from a crowbar. For four years it

slowly increased in size. It was then treated for about a year with applications of plaster, under the influence of which it slightly diminished in size. Since then the man had had no treatment. The lesion was more or less fungoid in its outer portion, and extended upward almost to the axilla. The axillary and supraclavicular glands were enlarged and hard. The man had been able to continue at his work, which was that of a laborer, until two months ago.

Dr. Coley said that this was the fourth case of cancer of the male breast that had come under his observation. In three of them there was a traumatic history. According to Roger Williams, the comparative frequency of this lesion in the male and female was as one to one hundred and seventeen, and in sixty per cent. of the cases there was an antecedent traumatic history. The duration of life averaged eight months longer in the male than in the female, and the number of cures following operation was comparatively small. In fourteen cases traced by Williams, only two remained exempt from recurrence.

DILATATION AND HYPERTROPHY OF THE STOMACH.

DR. CHARLES N. DOWD presented a woman, forty years of age, who was admitted to the General Memorial Hospital last January. For a year she had had gastric disturbance, which for several weeks had been extreme. Vomiting had been the most prominent symptom. This came at irregular intervals, usually after eating. The vomitus was usually sour undigested material, and on one or two occasions food returned which had been taken several days before. She was constipated, having one or two small movements a week, and she was much emaciated. The abdomen had become much distended, so that a diagnosis of large ovarian cyst had been made by more than one physician. She came to the Out-Patient Department of the hospital, and a stomach-tube was introduced and eleven pints of semifluid, very offensive material were withdrawn. A series of stomach washings was undertaken in the hospital to test the stomach's ability to empty itself, and it was found that although much of the food which was taken at supper could be withdrawn in the morning, the stomach would occasionally empty itself through the night. Analysis of the gastric contents showed absence of free hydrochloric acid and a

trace of lactic acid; total acidity, .2555; acid salts and organic acids, .1095; combined hydrochloric acid, .1450.

January 3d a gastro-enterostomy was done by the clamp method, attaching the uppermost part of the jejunum to the dependent part of the posterior stomach-wall. The stomach was so thick that it could not be held by the ordinary clamps which are used as an aid in sewing the stomach and intestinal walls together. The stomach-wall was about four times its ordinary thickness. The patient made an uneventful recovery; has gained very much in weight, and is now in good health. The condition was due to cicatricial pyloric stenosis, with no evidence of malignant growth.

ISCHÆMIC MUSCULAR ATROPHY.

DR. CHARLES N. DOWD said that in the April issue of the *ANNALS OF SURGERY* attention had been drawn to this condition by Dr. Ferguson, of Chicago. In the *Lancet* of January 11, 1902, there was an article by Dugeon, in which he reported four new cases and described eleven others, and there are many references to the subject in surgical literature under the terms Volkmann's contracture, ischæmic paralysis, ischæmic muscular atrophy, etc. It is certainly not pleasant to think that so serious a condition may result from a fracture treated apparently according to ordinary methods. Yet the patient which he now presented, was the second one who had been brought to St. Mary's Hospital with this condition during the year. The contracture ordinarily comes in children, and usually follows a fracture about the elbow-joint. In this instance, a child four years old, the fracture, just above the elbow-joint, occurred a year and a half ago. It was treated by putting the arm in splints and keeping it there for four weeks. After the removal of the splints only moderate stiffness in the elbow and fingers was noticed, but soon the fingers became more flexed, and inability to extend them was more noticeable. Their tips were drawn into the palm of the hand, so that the nails irritated the skin there. A sore also came on the tip of the little finger, which sloughed and healed at a later time. There was only moderate improvement for the following year, and when the child came to the hospital six months ago the fingers were contracted about half way to the palm, and could not



FIG. 1.—Ischæmic muscular atrophy with contracture of hand.

be extended unless the wrist was flexed, in which case they could be straightened, a characteristic symptom of this condition. The forearm was atrophied. The muscles on its anterior surface seemed hard. Sensation was good all over the arm, and the skin had almost a normal appearance, but was slightly glossy. The muscles all reacted to faradism. Supination was restricted to about half the normal amount. This symptom, the attending physician said, did not exist when the splints were first removed, but increased gradually.

The accompanying photograph shows the hand extended as far as she was able to extend it. She could flex the fingers so as to touch the palm. After consultation with neurologists, massage was used and was continued daily with much care for about three months, when she contracted measles. The gain under this treatment was so slight that it could not be appreciated. After her recovery from measles incisions were made to inspect the condition of the muscles and nerve. The flexor muscles of the forearm were found to be hard, fibrous, pale, and atrophied. The median nerve was somewhat pressed upon by the upper fragment of the old fracture, and seemed a little denser at the site of this pressure than below it. The musculo-spiral nerve seemed normal. The ulnar nerve was displaced, and lay to the inner side of the internal condyle instead of in the groove between it and the olecranon. No change in its texture could be distinguished. It was replaced in its proper position.

In the second case which has been treated in the hospital this winter a similar dissection onto the median nerve had shown that it was pressed upon by a sharp spicule of bone which projected from the upper fragment of the fracture. Sufficient time has not elapsed to determine whether the relief from pressure of these nerves will affect the contracture. The reports, however, from most of the cases which have occurred indicate that the lesion in the muscle cannot be ascribed to the nerve. Volkmann, in his original description, considered the muscle change to be due to anæmia, usually from splint-pressure, and this explanation has generally been accepted. In about half the cases which have been reported there are scars from pressure-sores over the muscles. A similar condition has been reported by Mr. Davies-Colley in the calf muscles from a fracture of the tibia and fibula and subsequent suppuration. In one instance a characteristic ischæmia

contracture of the forearm followed a bullet-wound in the axilla, with a thrombosis of the axillary artery. In neither of the speaker's cases has there been any evidence of a pressure-sore. The treatment which has been most successful is massage and tendon-lengthening. The speaker expected to lengthen the flexor tendons in this case unless improvement soon followed the massage.

DR. ROYAL WHITMAN said that the contraction was not entirely limited to the flexor muscles. In addition to the loss of supination and extension at the elbow, to which Dr. Dowd had referred, there was also some limitation of flexion at the wrist, the muscles on the dorsal surface of the forearm being somewhat shortened, as well as those on the flexor surface.

CHRONIC HYPERTROPHIC SYNOVITIS OF THE KNEE JOINT.

DR. JOHN A. HARTWELL presented a man, twenty years of age, who was admitted to the Lincoln Hospital on February 12, 1906, and gave the following history: In childhood he had some glandular enlargement in the neck, which required surgical attention. He had never been of a very robust type, but had been able to do hard work for several years past. About three years before admission, while jumping from a wagon, he sustained a slight injury of the right knee, which was not sufficient to cause disability at the time. The next day, however, the knee began to swell, and he gave up his work for four or five days, but was not confined to bed. Since that time he had worked continuously as an express-driver and handler, though his knee sometimes pained him a little, and was more or less swollen. For three weeks previous to admission these conditions had been rather more marked than before.

Physical examination on admittance to hospital: Appearance—Patient fairly well nourished; slightly anæmic; rather tubercular type. Heart—Normal. Lungs—Expansion poor; clavicles prominent; expiration prolonged at right apex; higher pitched; slight cogged-wheel rhythm. Abdomen—Negative. Glands—scar on left side of neck where glands were removed in childhood; otherwise glands not enlarged.

Extremities—Left shoulder slightly stiff, and painful on movement; right leg swollen at knee; not inflamed; no heat redness

nor pain when quiescent; all ligaments intact; movements restricted; flexion only to right angle; full extension possible; pain in the knee on walking; patella riding high; swelling laterally and up in cul-de-sac very marked; no movable bodies felt; no signs of fracture.

The extremities measured as follows: Right extremity—Calf, $10\frac{5}{8}$ in.; 6 in. above knee, $13\frac{1}{2}$ in.; above patella, $12\frac{5}{8}$ in.; over patella, $13\frac{3}{8}$ in.; below patella, $12\frac{3}{8}$ in. Left extremity—Calf, $11\frac{3}{8}$ in.; 6 in. above knee, $15\frac{1}{2}$ in.; above patella, $12\frac{1}{8}$ in.; over patella, $12\frac{5}{8}$ in.; below patella, $11\frac{3}{8}$ in.

The boy's general appearance, the scar of early glandular trouble in the neck, and the suspicious conditions found in the lungs, together with the very marked atrophy of the right thigh and leg, suggested the possibility of a tubercular synovitis. The absence of muscular spasm, of pain, and of any evidence of bone involvement after so long a history, argued, however, against this, and after ten days' rest in bed in order to allow the acute symptoms to subside, exploration was deemed advisable, and was done on February 20th, as follows:

After the usual preparation of the leg from the toes to the thigh an incision was made $3\frac{1}{2}$ inches long on the inner side of the patella. This was carried down through the skin and subcutaneous tissues, which were normal. Bleeding-points clamped. Incision was now made down through the joint capsule, which was found much thickened, and very vascular. Then the synovial membrane was opened. This was also very thick and succulent. Tissues cut with scissors to enlarge deeper cut to limits of skin incision. Joint cavity exposed and examined. Everywhere the synovial membrane was thickened with villous-like processes, and very vascular and inflamed. Bleeding-points caught as met. Ligamentum alaria especially inflamed. All the abnormal tissue now in sight was removed with scissors and forceps, including most of the ligamentum alaria. The joint was irrigated with hot saline solution. Leg was now flexed at the knee, and more of the fungoid material reached and cut away. Another irrigation followed. Tissue removed in notch down to crucial ligaments. Irrigation of the joint was again thoroughly accomplished. No disease of the bone found. Synovial membrane sewed up with continuous catgut suture, vessels being tied off with fine catgut. Capsule also closed with interrupted catgut;

skin with continuous silk. Rubber tissue drain carried down to the synovial membrane. Dressing applied, and leg put on posterior splint.

February 24th.—Rubber tissue drain removed. Wet dressing applied, because of a slight redness along the stitch-line.

February 26th.—Redness entirely subsided, and primary union resulted. The splint was removed on the twelfth day and passive motion of the joint allowed. Patient was allowed to walk on twelfth day and left the hospital three weeks after the operation. He returned to work on April 15th, about four weeks after the operation, and has had no difficulty with the joint since then. Examination at the present time, about five weeks after the operation, shows a normal functioning joint, with no effusion, and only a very slight thickening of the capsule. The atrophy of the thigh and leg, however, are the same as before the operation.

Pathological findings of the joint contents were as follows: Fluid consisted of blood-stained serum, with well-marked fibrin clot on standing. The cellular count showed: Polynuclear cells, 28 per cent.; small mononuclear, 6 per cent.; endothelial, 66 per cent.; red cells, 4 to 1 white. Section of synovial membrane shows thickening and hypertrophy of the membrane and fringes, due to (1) increased amount of fatty tissue; (2) new growth of connective tissue—*i.e.*, vascular and cellular tissue; (3) areas of small round-cell infiltration; (4) increase in depth of layer of marginal cells, closely packed connective-tissue cells, with little or no intercellular substance. No evidence of tubercular or purulent infiltration. Tissue and fluid were both found to contain no bacteria as tested by smears, cultures, stains, sections and injections into guinea-pigs.

Dr. Hartwell said he showed the case as one of chronic hypertrophic synovitis of the knee-joint, the *lipoma arborescens* of the German writers. The unusual features in the case, he thought, were the very marked atrophy where no actual disuse was present; the very good recovery following the operation, and the pathological condition within the joint, showing that these cases could probably be restored to health only in this way.

Dr. ROYAL WHITMAN said he did not think marked atrophy was particularly unusual in cases of persistent synovitis, or in any affection of the joint. Atrophy incidental to disuse did not neces-

sarily mean disuse of weight bearing and motion, but rather a physiological disuse which affected the nutrition of the muscles.

DR. HARTWELL, in reply to Dr. Whitman, said that in his case the patient had apparently used the affected limb very actively. His work was that of an expressman, and he was constantly jumping on and off the wagon. According to the history, he did not favor the limb at all until just prior to his admission to the hospital.

SUBDURAL HÆMORRHAGE.

DR. JOHN A. HARTWELL presented a man, aged 49 years, colored, who was admitted to Lincoln Hospital on February 27, 1906, with the following history: On February 21 he was struck on the head by a large piece of timber falling from a height of one or two stories. He was knocked to the ground, was picked up unconscious and taken to the Lebanon Hospital in an ambulance. He regained consciousness in about twenty minutes, but was excitable and irritable. There was a large scalp-wound over left parieto-temporal region, which was sutured. He continued in his irritable and rather unmanageable condition during the next six days without, however, manifesting any focal cerebral symptoms. In addition to his irritability, he had had several attacks of vomiting. On his admission to Lincoln Hospital, six days after the injury, the following notes were made: Patient has a healed scar on the left side of his head, six inches long and curved like an operative incision. Patient seems drowsy, yet at intervals he is irritable, restless and unmanageable, trying to get out of bed. Patient does not respond to questions, and on being aroused, looks at one with a vacant expression. Heart, lungs and abdomen, all negative. Extremities: No change in sensations apparent. No paresis or paralysis. Reflexes, markedly increased. Control of bladder and rectum perfect. No facial paralysis or change in pupils.

Shortly after admission patient had a convulsion, which was reported by the attendant to be general in character. During the following three days the convulsions were repeated several times, were of very short duration, and no evidence that they were at all localized could be obtained. On March 2 these convulsions began to occur with great frequency, about every twenty minutes,

for periods of an hour at a time, followed by a period of rest. They were becoming longer in duration, and the following notes on their character were then made: First there was a vacant staring expression of the eyes, with a gradual conjugate deviation toward the left; after about four or five seconds there was a tonic contraction of the muscles of the left side of the face, then a drawing of the head downward on the left shoulder with an elevation of the latter; then tonic contractions in the arm, and then in the leg of left side. This phase occupied about fifteen seconds, and was followed by clonic spasms of the same parts and in the same order. The whole convulsion lasted from sixty to ninety seconds, during which the patient was totally unconscious. He then gradually regained consciousness and the contractions ceased. At this time, when he had had altogether about twelve convulsions, he for the first time showed a decided left facial paralysis and marked weakness of left arm and leg. This was on the ninth day after the injury, the first convulsion having been noted on the seventh. On the eighth day his condition was apparently improved. Operation was performed March 2, nine days after the injury, and as soon as the localized character of the convulsion and the paralysis was evident. Under ether, a curved incision was made just above the right temporal ridge, about eight inches in length and carried directly down to the skull, the flap being turned downward. The fissure of Rolando was now marked out, and a trephine opening made over the face center and enlarged upward with the trephine to an area of about two inches in diameter. The dura showed no pulsation, and a clot could be seen beneath it. Dura was divided around the line of the bone opening, and a large organized clot was removed from the cerebral cortex. Electrodes applied to the facial center produced a prompt contraction of the muscles of the face on the left side. No response could be obtained in either of the extremities, possibly because the nerve-cells here were too much damaged by the compression, though the paralysis of the face had indicated a greater involvement of the cells for that part. Inspection, however, indicated that the cells for the arm were more damaged than those of the face. The opening in the skull was hardly extensive enough to reach the leg center. The dura mater was closed with catgut sutures, a small, rubber tissue drain put down through it, and the scalp sutured back in place. It was noted

that the scalp was quite œdematous, probably due to lymphangitis following the original scalp-wound.

Postoperative notes: March 4—Recovered from anæsthetic without incident. Slightly excited during first twelve hours and then became rational, but continues rather stuporous. Can be aroused, and gives correct account of injury and other details of his residence, work, etc. Still has considerable weakness of left upper extremity, and less of the lower extremity. Is able to make coördinated movements. Slight spasticity of lower extremity left side, none of upper. Left-sided facial paralysis, and left deviation of tongue. Upper branch of facial less paralyzed than lower. Examination of reflexes unsatisfactory. No ocular paralysis.

March 6.—Patient less rational than formerly. More stuporous. Complains of pressure on head. Very restless. Left arm can be moved only with great difficulty. Face more markedly paralyzed. Wound examined and pus found along the suture line. Considerable distention. Opened after stitches were removed. Infection all through the scalp, due to previous lymphangitis. Pus infiltrating tissues down to the dura. Dura thickened and brain apparently well walled off by dense adhesions. Wound area opened up widely and dressed with free drainage and bichloride solution.

March 9.—Wound very much cleaner. Both sides granulating well. In center, still suppurating. Left arm can be moved more freely.

March 11.—Wound granulating well. Patient more rational. Movements on left side stronger.

March 13.—Patient improves slowly. Mind brighter. Movements of left side gradually returning. Can put left hand to nose and mouth with effort. Cannot hold up a single finger of left hand.

March 15.—Wound granulating well. Pulsations fair. Complains of being in bed. Left facial paralysis less marked. Can nearly hold up finger of left hand.

March 27.—Wound granulating well; nearly free from pus. Mental condition practically normal. Left leg can be used nearly as well as the right. Left arm not so powerful as right. Power of coördinated movements not entirely regained. With eyes shut, fingers do not meet by several inches. Left not so strong as right.

Facial paralysis still slightly present on left side of face. Left eye cannot be shut tight. Left angle of mouth can be drawn back but a very little.

April 10.—Patient was discharged, forty days after the operation. Wounds entirely closed, but still showed slight incoördination of left side of body, and slight left-sided facial paralysis. He walks without any dragging of the foot. Mentally, he is normal.

April 25.—Eight weeks after the operation there is absolutely no evidence of his injury remaining except the scars on his head, and the brain pulsation beneath the opening in the skull. There is no evidence of any irritability of the brain due to adherent dura.

THE ADVISABILITY OF EARLY OPERATION IN INTRACRANIAL HÆMORRHAGE OF TRAUMATIC ORIGIN.

DR. FRANK W. MURRAY read a paper with the above title (for which see page 374).

DR. JOHN A. HARTWELL said the condition of intracranial hæmorrhage of traumatic origin, which Dr. Murray had discussed in his paper, was constantly coming under the observation of the surgeon, especially in hospital practice, and it was often very difficult for him to decide what to do. The problems that confronted the surgeon were whether the condition was sufficiently localized to admit of operation, and, furthermore, whether he would be able to locate the site of the hæmorrhage.

In a case reported at one of the previous meetings of the Society, Dr. Hartwell said, the patient, a child, was brought to the hospital in a semi-comatose condition as the result of a fall on the head. Within thirty minutes after admission, the coma was complete. There were no localizing symptoms, and in their absence, Dr. Hartwell decided to do the decompression operation as described by Cushing, turning down the fascia of the temporal muscle, splitting the muscle, and then trephining over the so-called "silent area." The dura was found much distended, and upon incising it, serosanguineous fluid spurted out with considerable force. The brain was œdematous in appearance, and there was no pulsation in it for several minutes after opening the dura; then the pulsations returned, and its appearance became normal.

The intracranial pressure was so great that it was impossible

to suture the dura in its normal position. The muscles, however, were sutured, and the child made an uneventful recovery, and two and a half months later showed no evidence of trouble from the loss of bone and dura. Prior to the accident, the child had been slightly deaf on the affected side, and subsequently that defect became more pronounced.

In the second case reported by Dr. Hartwell, the patient, after a fall of six or eight feet, sustained a very severe injury of the head. Upon examination, he had a large hæmatoma of the skull, but there were no signs of fracture. Upon operation, a large subdural hæmorrhage was found, extending over the whole surface of the brain. The patient died shortly afterwards, and at the necropsy, a slight fracture at the base was found. The symptoms in this case were those of severe concussion, which was practically caused by multiple minute hæmorrhages from the small vessels of the brain.

Dr. Hartwell said he agreed with Dr. Murray that if these cases were more carefully watched, many could be saved by early operative interference. Operation was too often neglected because of the absolute absence of localizing symptoms.

DR. GEORGE WOOLSEY said he was interested in the statement made by Dr. Murray in regard to the relative number of cases in which there was no actual injury to the brain, only the compression from the clot. In many cases there were no localizing symptoms, and sometimes it even could not be determined whether or where a blow had been struck. In these cases of head injury, neurologists were rather inclined to attribute the symptoms to actual laceration of the brain, and were rather disinclined to advise operative interference. Personally, Dr. Woolsey said, he favored an exploratory operation in every instance where there were any focal symptoms of pressure, or where there was a localized injury with general pressure symptoms.

Last summer, Dr. Woolsey said, a boy was brought to the hospital after having sustained a fall from a fire escape. He had mild convulsions, with intervals of semi-coma, there was a moderately slow pulse, and some symptoms indicating brain-pressure. An operation was done, and upon incising the dura, no hæmorrhage was found, but there was an increased amount of cerebro-spinal fluid, and the surface of the brain was boggy and œdematous. The evacuation of the cerebro-spinal fluid gave

the patient some relief, and he eventually made a good recovery. In that case there were no evidences of a clot to account for the symptoms.

DR. MURRAY, in closing, said a history of trauma was one of the most important factors in deciding the surgeon to operate. Of course, where there was depression of bone the indications for surgical interference were clear, but in many of these cases there was simply a hæmatoma. In cases of subdural hæmorrhage where the coma often persisted for days, and in dealing with which the attitude of most surgeons was very conservative, the speaker thought that an exploratory operation was advisable, in spite of the old idea taught in the text-books that most of those cases would recover without operation. The chief points that influenced him to operate on such a case were the appearance of choked disk, slow pulse, and increased blood-pressure as indicated by the manometer.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, May 7, 1906.

The President, JOHN B. ROBERTS, M.D., in the Chair.

OSTEOTOMY FOR ADOLESCENT RACHITIS.

DR. JAMES K. YOUNG presented a lad, fifteen years of age, who was admitted to the Polyclinic Hospital June 10, 1905, with a well-marked genu varum of the left leg, which had developed during the preceding three months. The shortening was considerable, and he wore a high shoe until the time of the operation. He sought relief from the pain and disability caused by the deformity in the joint. The point of greatest deformity in the bone was just below the tuberosity of the tibia.

Osteotomy of the tibia and fibula was performed at the point of greatest deformity. He was dressed in a fracture-box with compresses, and the recovery was uneventful except for a consecutive hæmorrhage which occurred from the fibular wound. Dr. Young said that osteotomy at this point is exceedingly difficult, on account of the danger of wounding the anterior tibial artery, the peroneal nerve, and the posterior tibial artery, and also because the section has to be very freely made on account of being very near the joint, but the result of the osteotomy in this case is perfect.

ANASTOMOSIS OF THE EXTERNAL AND INTERNAL POPLITEAL NERVES FOR INFANTILE PARALYSIS.

DR. JAMES K. YOUNG reported the case of a girl seven years of age, who applied to the Polyclinic Hospital November 29, 1904, on account of infantile paralysis of the left leg.

When two years old a paralysis of the left leg developed, so that she could not walk for six weeks. Was taken to various hospitals and treated by electricity and massage, after which she was enabled to walk. Had had no treatment for several years. She was a well-nourished child, well developed for her years. Left leg showed shortening, and there was a limp present in left leg.

Measurements—

Right leg....Length, 23 in. Calf.... $9\frac{1}{2}$ in. Thigh.... $12\frac{1}{2}$ in.

Left leg.....Length, $22\frac{1}{4}$ in. Calf.... $6\frac{1}{2}$ in. Thigh.... $11\frac{1}{2}$ in.

The entire distribution of the motor-tract of the external popliteal was paralyzed except the extensor longus digitorum, which showed a very feeble power of extension, only to be detected by careful observation. Sensation was normal.

Operation of nerve anastomosis, suggested by Dr. Wm. G. Spiller, was performed December 8, 1904. The operation consisted in a total central peripheral transplantation of the external popliteal into the internal popliteal nerve.

The technique of this operation does not differ from that employed in nerve anastomoses of other parts. The object sought is to transplant the nerve in such a manner as to place the central nerve axis of the paralyzed nerve in the same direction as the central nerve axis of the sound nerve.

The region was exposed by an incision six inches long, beginning at the middle of the posterior aspect of the thigh and terminating at the inner side of the biceps tendon. The external popliteal was first exposed and then the internal popliteal. The external popliteal was divided and attached to an incision in the internal popliteal. It was held in place by three chromicized catgut sutures. The wound was closed with catgut sutures and dressed in a plaster-of-paris case.

Sensation in the toes over the distribution of the musculo-cutaneous nerves returned in twenty-four hours. For three months afterward there was no improvement in the motor power or in the growth of the limb. Growth was then resumed and has since continued uninterrupted and more rapid, and the circulation has improved. There has been no loss of power in the extensor longus digitorum, but a slight increase of function, and the limb is more useful than before the operation.

DR. WILLIAM G. SPILLER said that in this case in which only a little motion was preserved in the extensor longus digitorum before operation, the question arose as to whether the nerve in this muscle should be sacrificed. As only slight power persisted it seemed proper to sacrifice the nerve. It would not be destroyed by the operation, but its power would be distributed over the entire region of the popliteal.

DR. YOUNG, in closing, replied to a question as to whether the operation of anastomosis was of value in cases in which distinct reactions of degeneration were present. Dr. Young was at one time extremely doubtful that benefit was derived from anastomosis in such cases. After hearing Hoffa's statements at Atlantic City a few years ago he is inclined to believe that restoration is possible even when the reactions of degeneration are present. The appearance of the muscles themselves is the best guide to prognosis in these cases. The color varies from a dark red to pink or to a yellow tinge. The last indicates that the muscle is fatty; in these the reactions of degeneration are most marked. The reactions are in all cases difficult to determine, as admitted by neurologists, and may in some instances not be obtained. One is not sure that degeneration is not present even when the reaction is lacking. As to the technic of anastomosis, some surgeons do not employ sutures in the sheaths of the nerves. Dr. Young prefers to pass the anastomosing nerve entirely through the opening in the other and then suture at three points. The nerve then falls back until the ends of the axis-cylinders are in direct apposition with the same structures in the sound nerve. The new nerve in this way grows directly into the central axis of the sound nerve. The placing of three sutures refers only to nerves large enough to accommodate so many; in small nerves two or even one will have to suffice.

THE RELATION OF THE TECHNIQUE OF NURSES AND OF HOSPITAL APPARATUS TO THE HEALING OF WOUNDS.

DR. CHARLES P. NOBLE by invitation read a paper with the above title (for which see page 431).

DR. GEORGE ERETY SHOEMAKER said there was possibly a needless elaboration in some of the points detailed by Dr. Noble,

but at the same time there is no doubt that surgeons cannot be too careful in securing asepsis. Boiled rubber gloves for the nurse who is preparing the patient solve some of the problems. A source of infection in operative cases is the slipping of the dressing applied by the nurse after preparing the operation site. This is especially true in cases in which plastic precede abdominal operations. He believes the free use of formalin as recommended by Dr. Noble will be found to cause a dermatitis in some nurses. In the hospital where he does much of his work they put a formalin solution in the wash-basins of the operating-room one hour before using them, but the hands are washed in running water. The stationary wash-basin may be a prolific source of infection.

DR. JAMES K. YOUNG remarked that nothing had been said by Dr. Noble regarding the use of gloves. He always uses rubber gloves and thus eliminates one source of infection.

DR. GWILYM G. DAVIS regards the boiling of basins as a perfectly satisfactory plan. At the Orthopedic Hospital they use a large, square, steam-heated box for this purpose. He prefers that the nurses in the operating-room should wear gloves, just the same as do his assistants. As to the dirty basins for washing the hands, that feature can easily be avoided by the use of running water and the rose spray.

DR. JOHN B. ROBERTS said an important point in this question of asepsis seems to be that no one can do good surgery unless he is in absolute control of a hospital. The value of this feature is shown by the excellent suggestions of Dr. Noble. Such details as he enumerates cannot be carried out in a hospital where four or six surgeons change at intervals, as in one institution with which Dr. Roberts is connected. The preparation of the nurses is an important part of surgical technique. In this connection it may be said that practically all surgeons are guilty of hurrying the nurses and not giving them time properly to attend to aseptic technique when an operation is at hand. In addition to those already named, a source of infection is the exposure of wounds often seen during ward visits. This is particularly true of wounds about the groin or in other places difficult to bandage, the wound being uncovered by the slipping of the dressing improperly applied by the resident who dressed the case.

DR. NOBLE, in closing, said he was not at first prepared to believe that infection of wounds came from infection of the skin

before operation, but a series of infections had conclusively proved its possibility. As to Dr. Shoemaker's statements regarding the impracticability of formalin, all the nurses in his hospital have used it for some years. Two or three thought it caused dermatitis. They were permitted to substitute bichlorid for the formalin. There is no difficulty with its use except in cases of idiosyncrasy. Regarding sterilization of the waste-cans in the wards, if one sees how easy it is to do this he would no longer be willing to let them go without it. Dr. Noble has for years used rubber gloves. They are of great value in keeping the surgeon's skin from infection, and also for protecting the wound, thus working both ways. He wears them in all except trifling operations. The rose spray installed in the hospital as described by him is the same type as mentioned by Dr. Davis. It can be manipulated by the feet or by the elbow of the surgeon. It works by an ordinary lever pressed in by the feet, the latter being aided by a catch which holds the lever open after it is pressed by the foot. To mix the water properly there is an ordinary valve shut-off on both hot and cold supply-pipes. In manipulating the flow of water in any way desired, the surgeon does not need to use his hands at any time.

DISLOCATION OF A VERTEBRA.

DR. EDWARD MARTIN (and by invitation, DR. WILLIAM G. SPILLER) reported the case of a boy, an athlete, who was wrestling. His opponent was holding him with his head on the ground and endeavoring to force down his shoulders. Suddenly the boy collapsed and became totally paralyzed. When he was examined there at once arose the question of operation. There was evidence of either a total transverse lesion or of a twist or stretch of the cord. It was decided to wait until this point was decided. The persistence of the paralysis for three days furnished proof of a total transverse lesion. Whether it was due to a dislocation of a vertebra or to a tear could not be determined. X-ray examination was unsatisfactory, but seemed to show a lesion of the sixth cervical vertebra. Laminectomy appeared to offer nothing, and hence it was not performed. In spite of all that is said to the contrary, laminectomy is not a safe procedure. If, however, his neck was injured in this way, Dr. Martin would like the operation done. It gives a possible chance

of replacing a bony fragment or of removing a clot, and at least would hasten death if it did not relieve. Dr. Martin's experience with laminectomy is that improvement after the operation is the same as occurs in cases treated without operation. The lesion in the case reported proved to be a luxation of the seventh cervical vertebra which had been spontaneously reduced, there being no fracture and yet a complete transverse lesion of the cord.

DR. SPILLER said that when he examined the young man, a few hours after the injury, there was complete paralysis of the lower extremities. Sensation was completely lost as high as the umbilicus, and there was a zone of disturbed sensation between the umbilicus and the nipple line, by the following day the area of anæsthesia had extended as high as the third rib. The reflexes were entirely absent in the lower extremities. There was voluntary movement of the shoulders, the elbows, and the wrists. There was no grasp in the right hand and but little in the left. The signs were those of complete transverse lesion of the cord, and the level of the lesion was easy to determine. The disturbances of sensation on the inner side of each upper limb and the loss of power in the muscles of the hands—*i.e.*, in the distribution of the first thoracic and eighth cervical roots, pointed to a lesion in the corresponding segments of the cord, and hence the case was perfectly clear. All who saw the patient agreed that operation was not advisable. The question of operating in these cases is now greatly in dispute. Dr. Spiller is conservative in this regard and doubts if laminectomy is of value in fracture of the vertebræ. Some surgeons say that the chief cause of the paralysis is pressure by displaced bone and that restoration of function will follow removal of the fragments. As a matter of fact there is not extramedullary hæmorrhage in most cases. Usually there is disturbance of the cord due to the injury that produced the fracture, and whatever damage may have been done by displaced bone has occurred at the moment the displacement occurred. When the cord is thus injured no removal of pressure, if this exists, can restore it. In most instances the cord is mashed, and often there is softening and even hæmorrhage within the cord when the cord externally appears normal. Autopsy in the case under discussion showed there was no hæmorrhage on any part of the cord, either external or internal to the dura. At the eighth

cervical segment was marked compression of the cord, with swelling above and below. Microscopically marked degenerative changes are present in and above the compressed area, hæmorrhage within, and intense disintegration of the cord being shown. This same condition is found in many of the cases of similar injury to the cord. There is also some change in the sacral region in this case and Dr. Spiller is inclined to believe there was a temporary dislocation in the lumbar vertebræ, although this was not suspected before death or at the necropsy. The lower end of the cord is partly separated from the rest or reduplicated. This is possibly a congenital malformation.

DR. WILLIAM J. TAYLOR said that he had now under his care a man who eighteen months ago fell 42 feet, this rendering him unconscious for several hours. He was paralyzed for six weeks after the accident, when Dr. Taylor first saw him. By the X-rays it was thought possible to detect a fracture-dislocation of the first lumbar vertebra. The patient was put on the table in preparation for laminectomy, but a careful examination before ether was given revealed slight motion in one leg. The operation was not done and a plaster jacket was applied. The patient has continued improving up to the present time. He was in the hospital from September to February. He now has perfect motion and has no difficulty in walking. The greatest trouble now is when he leans over with the knees fixed, as this gives him intense pain down both thighs. The pain is not noticed if the knees are bent at the time he stoops.

DR. JAMES K. YOUNG said he had under his care for many years a girl who showed the happy results of laminectomy. She was an aeronaut who fell 100 feet and sustained a fracture in the lower dorsal region and was operated upon by laminectomy by the late Dr. Ashhurst. He took the chances of operating and removed a fragment of bone. The patient is now able to walk. There is of late years a tendency among surgeons not to operate upon cases of tuberculous paraplegia. Dr. Young does operate upon such cases. One patient referred to him by other surgeons now, as the result of operation, has the use of her limbs.

DR. CHARLES H. FRAZIER said regarding the etiology of the injury in the case reported, Dr. McKenzie, the physical instructor, stated that at the time of the accident the boy was much fatigued

from long-continued exercise and wrestling, and he believes the muscles failed to give proper support to the parts involved. Dr. McKenzie does not know of any other case of like injury.

DR. MARTIN, in closing, said the possible lesion in the lumbar region would help explain one puzzling symptom. In the case of a lesion high in the cord there should be incontinence rather than retention of urine. Here there was retention, which was suggestive of a lesion in the lumbar region.

AN EXPERIMENTAL STUDY OF SUTURE OF ARTERIES, WITH A DESCRIPTION OF A NEW SUTURE.

DR. GEORGE M. DORRANCE by invitation read a paper, with the above title (for which see page 409). He exhibited a series of specimens and demonstrated the application of the suture.

PERFORATION OF SKULL BY IRON ROD.

DR. C. G. ROSS reported the case of a man who was brought to the hospital March 20, with the history of having been struck over the leg center of the left side of the head by the end of a three-eighths-inch steel rod six-and-one-half feet long, which fell fifty feet. The pupils were dilated and did not react, and vomiting had occurred. There was doubt as to the advisability of immediate operation. The man did not develop convulsions. Operation was finally performed and showed that the iron had made a round hole in the skull as accurately as it could have been done by a trephine. The superior longitudinal sinus had been entered, but the button of bone prevented hæmorrhage. The inner table of the skull was compressing the leg center. When removal was accomplished, hæmorrhage was severe, and packing had to be kept in for seven days. When the packing was removed, motion in the leg was possible, and the man finally walked out of the hospital.

ENDOTHELIOMA OF THE CAROTID GLAND.

DR. J. CHALMERS DACOSTA read a paper with the above title (for which see page 393).

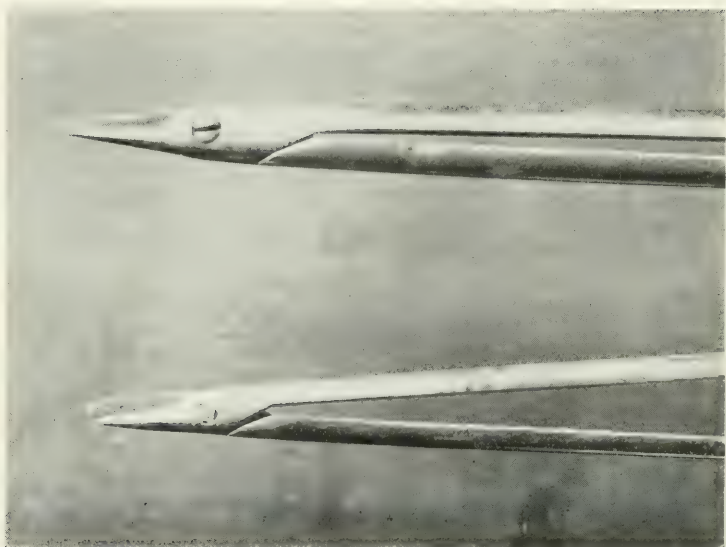


FIG. 1.—Scissors with one blade blunt pointed and hooked for removal of invisible or deep sutures.

SCISSORS FOR THE REMOVAL OF DEEP-SEATED INVISIBLE SUTURES.

DR. GEORGE ERETY SHOEMAKER exhibited scissors (Fig. 1) for the removal of deep-seated invisible sutures. He said that the suture or ligature which passes through dense structures in the lower part of its path is apt to bury its superficial portion with the knot, especially when tied upon mucous surfaces. There are certain localities, such as the rectum, the upper portion of the vagina, certain deeper parts of the wound in operations for gall-bladder drainage, and after vaginal hysterectomy, where ligatures or sutures may be almost or quite invisible and, because of distance from the operation, difficult to remove. The inside sutures of a properly-conducted Emmett operation for perineal repair are difficult to reach without such stretching of the parts as will imperil the recent union. For a number of years he had used scissors which safely remove such sutures, without laceration or over distention of the parts. These differ essentially from others having a hook on one or both blades, and may be described as follows: One blade has a blunt or probe point turned up not more than a twelfth of an inch, or to a point in a line with the back of the other blade when closed. The second blade is so much shorter than the first that there is just room for a silk wormgut suture to lie in the grasp of the hook, without being thrown out as the scissors are opened. The entire length of the instrument should be at least six-and-a-half inches. In order to use these scissors successfully, one end of the suture only should be left long after tying, the other being cut off close to the knot. For removal this long suture end is grasped and put upon the stretch, thereby furnishing a guide for the point of the scissors down to the loop to be cut in the depths of the part. The scissors, being slid along this guide, are introduced closed like a probe into the loop of suture, which is readily found when under the tension described. The suture is engaged in the hooked blade with the scissors still closed. The latter are then moved a little to one side to avoid cutting a knot. The tension is now removed from the long suture end previously held taut, and if the hook does not at once become disengaged it is evident that it is within the real loop of the suture. The scissors may now be confidently opened and shut, as the short blade does not throw out the suture, which

will now slip between the blades and the entire suture may be drawn out by the long end above referred to.

The important points are, that the scissors should be introduced closed, that no part of the hook should be sharpened, and that all edges be somewhat dull, in order that the suture may not be prematurely cut while feeling for the proper adjustment of the loop.

These scissors were made for him by Mr. Gemrig about ten years ago and have been used with great satisfaction ever since, particularly after vaginal hysterectomy and perineal operations.

TRANSACTIONS

OF THE

CHICAGO SURGICAL SOCIETY

Stated Meeting, April 6, 1906.

The President, DR. D. A. K. STEELE, in the Chair.

TABETIC DISEASE OF KNEE-JOINT.

DR. DANIEL N. EISENDRATH presented two cases of tabetic disease of the knee-joint, one in a woman, aged forty-five, and the other in a man, aged sixty. In both cases the most marked pathological feature was the enormous enlargement of the lower end of the femur, as shown by the X-ray. In one case this was so marked as to simulate an osteosarcoma of the lower end of the femur (see Fig. 1). This latter patient had been sent to the speaker with such a diagnosis. Examination of the patient, however, confirmed the diagnosis of tabes dorsalis. Another interesting feature of both cases was a marked increase in lateral mobility, especially in an outward direction. This was due to the enormous distention of the capsule, and subsequent stretching of the ligaments. Operative treatment had been advised in both cases, on account of this laxity of the joint. Resection of the ends of the bones was indicated in preference to amputation above the knee. A number of cases have been reported in which such typical resections have resulted satisfactorily.

Dr. Eisendrath also showed a patient upon whom he had performed nephrectomy for unilateral septic nephritis.

THE TECHNIQUE OF OPERATIONS UPON THE HEAD AND NECK.

DR. GEORGE W. CRILE, of Cleveland, Ohio, read a paper with the above title.

DR. ARTHUR DEAN BEVAN said that he had seen Dr. Crile operate on a neck case a short time ago, at the Lakeside Hospital, in Cleveland, when he employed the general technique which he had described, such as the elevated position of the patient's head, with rubber suit, etc., and with this elevated position of the patient's head the speaker was sure that the field of operation was maintained in a condition where there was much less blood, and where the dissection was much easier than in any case of neck work he had ever seen.

He had not had the opportunity to use temporary clamping of the common carotid artery in any of his surgical work on the neck. He expressed himself as having been a pessimist (and he was not at all proud of it) as to the general proposition of carcinoma of the head and neck with glandular involvement. He thought his position was now about what Dr. Crile's had been in the past as to the results which could be obtained by radical surgical treatment. His own surgical results had certainly been discouraging when there was evident glandular involvement in carcinoma. He was quite sure, however, that the position which Dr. Crile had taken was the correct one, as had been demonstrated without much doubt in connection with carcinoma of the breast, namely, that if we were to obtain radical results by surgical means, the operations must be exceedingly radical; that the operation must be so wide and sweeping as to remove the regional involvement, or else we would sooner or later get a recurrence.

He had been impressed with the desirability of the point which Dr. Crile mentioned in connection with the removal of the internal jugular vein in a number of these cases. He knew that in some of his earlier work he had attempted to leave the internal jugular vein and to dissect out the glands in close contact with it, which were grossly involved—a very stupid error, he now thought—and yet he had been governed by an early bias which led him to attach too much importance to the jugular vein as an important part of the economy. The internal jugular vein undoubtedly could be removed with little more risk than was involved in the



FIG. 1.—Tabetic disease of knee-joint.



FIG. 2.—X-ray of a tabetic knee-joint. Note the hypertrophic condition of the internal condyle of the femur which simulated a neoplasm.

removal of the external jugular vein, although, of course, there was a certain mortality from its removal. This, however, was very small.

He had never employed the method which Dr. Crile suggested in regard to giving the anæsthetic in these cases. It impressed him very favorably. He had employed a somewhat similar scheme of using rubber tubes through the nose down to the epiglottis, and walling off with large pads in sponge holders in front of the epiglottis, without packing the pharynx, as Dr. Crile had suggested.

He had been very much impressed with one point in connection with carcinoma work generally about the face and head, and that was the desirability of ligating the external carotid. He had been a little afraid to interfere with the common carotid, but as almost a routine in his work he had ligated the external carotid in extensive malignant disease of the face, with some considerable satisfaction.

DR. E. WYLLYS ANDREWS said that to understand the work of Dr. Crile, it was necessary for surgeons to read his other contributions to the literature on this subject in the last few years, and particularly in the last year. He had known about this temporary clamping of the carotid artery for several years, but had never dared to resort to it himself, because he had not actually seen it used.

It was perfectly obvious that Dr. Crile had started out in a direction where there was absolutely no precedent in the kind of work he was doing on the head and neck. He had created a new field of surgery here. Anyone who would review the literature of the last few years must come to the conclusion that it was almost revolutionary. The comparison that Dr. Crile made with the Halsted operation on the breast and his operations upon the neck explained a great deal. The radical breast operation, as advocated first by Willy Meyer and later by Halsted, put breast surgery on a new status, and Dr. Crile had created a new surgical status for the neck and head. The surgery of these parts was exactly parallel in laying great emphasis on dealing with the lymphatics.

The speaker felt that his own work had not been radical enough. He had tied one of the carotid arteries many times, dissecting half of the jaw or face, cutting down, and thinking that

the only way to make the operation feasible was to tie the common carotid, thereby getting a high mortality, but finally ending by doing no such radical and successful work as had been accomplished by Dr. Crile in the remarkably ingenious steps which he had described. To think seriously, many novel things had been presented by the essayist. Three or four of the steps he had described were entirely unknown until brought out by him, as, for instance, taking off the sternocleidomastoid, sacrificing it, and liberally sacrificing the internal jugular vein all the way up, reflecting the great skin flaps, exposing the field away beyond the line where the normal glands lay, discovering the easy line of cleavage in this deep plane.

DR. A. J. OCHSNER said that some five years ago he had had the good fortune of seeing Dr. Crile work for three days. He also saw some of his early work in this field. Since that time he had employed Dr. Crile's clamp in a number of operations, and had used the position which he had demonstrated, and had borne in mind one of the features which Dr. Crile pointed out at that time very forcibly, but which he only hinted at now, and which was of very great importance, especially in operations for the removal of portions of the thyroid gland in cases of exophthalmic goitre. In that particular class of cases it was of especial value, namely, after thoroughly anæsthetizing the patient, elevating the head and leaving the patient in this position during the operation, one could readily complete the operation without any further use of the anæsthetic. The anæmia of the brain which occurred as the result of this change of position would cause the amount of anæsthetic which had been given previously to suffice for the entire operation. He believed that this one point now did away with the necessity of operating upon these patients under cocaine. The comfort of an excision of an exophthalmic goitre was tremendously increased by the method which Dr. Crile had introduced, in that the patient was thoroughly under the anæsthetic until the surgeon reached the point of separating the gland from the trachea. About that time the patient began to speak, so that the surgeon had the comfortable feeling of knowing that he had not injured the recurrent laryngeal. Hæmorrhage was controlled, the ligatures applied, and the patient placed in a horizontal position again, and, if necessary, an anæsthetic could be given for suturing the skin wound. Since he had learned the

application of this method to this one operation, he had gotten a lot of comfort out of it. These little clamps were very satisfactory; and from an examination of the retractor which Dr. Crile had shown, he was sure that he should use it hereafter, as it was much better than the bent spoon handle, or a similar retractor, in that it was out of the way and still did the work effectively. The dental instrument was an ingenious contrivance.

DR. M. L. HARRIS said that without a practical knowledge of regional anatomy the valuable points which Dr. Crile had presented could not be clearly understood, nor their importance realized. A thorough knowledge of the lymphatic glands of the territories which were drained into certain lymphatic areas was of great importance. This was no better shown than in the difference in mortality rate from metastases which were found in cases of carcinoma of the lip and of the tongue. It had long been known that carcinoma of the tongue was much more malignant than carcinoma of the lip, and that operations for the removal of carcinoma of the tongue were much less successful than those for the removal of carcinoma of the lip. This was due largely to the lymphatic distribution. The lymphatics from the lip, for instance, converged to a more central point than do the lymphatics from the tongue. From the tongue the lymphatics pass to glands at the base of the tongue and the submental glands, to those in the upper triangle and to others as low down as the omohyoid muscle.

He emphasized the importance of removing the jugular vein in malignant diseases in these cases. This was again impressed upon him only recently. Two weeks ago he did an operation for carcinoma of the larynx, removing the glands in that vicinity. In removing the metastases in the glands of the neck he had to take away also all the vessels, namely, the common carotid, the external and internal carotid, and the jugular vein, in one mass. On examining the specimen subsequently to satisfy himself whether he had really done right in taking out so much of the blood supply, he was surprised to find on the inner wall of the internal jugular vein a small metastasis. He thought it was perfectly easy to leave such a metastasis. This case impressed upon him the great importance of sacrificing these vessels when necessary in these cases.

A German author, two or three years ago, in commenting on

the removal of the internal jugular vein, stated that statistics showed that the removal of the right internal jugular vein was five times more liable to be followed by brain trouble than the removal of the left, because of the fact that the left jugular foramen, at the base of the skull, was abnormal in size five times oftener than the right. In other words, the right internal jugular vein was larger and more uniform in size. He wondered if Dr. Crile had noticed any difference in the mortality on that account.

The little points of technique in the removal of the Gasserian ganglion would be appreciated by everyone who had done this operation, and, personally, he was indebted to Dr. Crile for bringing them out. This was particularly true as the surgeon had to operate in a limited space, and the bottom of the field of operation was consequently relatively very deep. Dr. Crile had spoken of placing forceps on the nerves, but this Dr. Harris thought took up more or less room, and he had found it of advantage to pass a silk ligature around the nerves, which enabled him to get rid of the forceps, and the nerves could be followed up without the interference of the forceps.

DR. DANIEL N. EISENDRATH asked Dr. Crile: First, after releasing the clamp following the temporary closure of the common carotid artery, to what extent did hæmorrhage follow the taking off of the clamp again from the terminal branches of the arteries? Second, in what percentage of his cases, if any, had there been cerebral embolism following temporary ligation of the common carotid? Third, whether he had ever performed a preliminary tracheotomy, or tracheotomy at any stage, at the time of the operation, or say a week before as a preliminary step?

He debated that question a good deal with himself lately in two cases of carcinoma of the tongue, one of which was an extensive carcinoma of this organ which was not brought to him until an ulcer had appeared at the floor of the mouth. He ligated both external carotids, but did not think it was necessary to perform a preliminary tracheotomy. The hæmorrhage was no greater than would follow the amputation of leg where a constrictor had been applied. This patient, however, died of aspiration pneumonia. Dr. Eisendrath asked Dr. Crile whether in such radical operations as this—carcinoma of the tongue, or carcinoma of the glands of the neck—he found it necessary to perform a preliminary tracheotomy. Fourth, given a case of

carcinoma of the lip in the early stage, or a carcinoma of the tongue which had not advanced to an extensive degree, would the operation be as radical as that which he had outlined, namely, removing the whole cervical lymph node area?

DR. D. W. GRAHAM said that, regarding the removal of the jugular vein, he had been accustomed, when he wanted to dissect out a carcinomatous mass in the region, to cut the vein and muscle just below the tumor, and following down towards the clavicle as far as was necessary; then ligating below, and turning the other end up with the tumor as high as it was deemed necessary to go. In these cases he had discovered that the lumen of the jugular vein was sometimes obliterated and frequently partially obliterated, so that beginning there it was probably easier to remove the vein down from that point than it would be to start just above the clavicle, although he could see how Dr. Crile's method might be better in some instances.

Regarding the removal of the Gasserian ganglion, he thought there was some advantage in what Dr. Crile had recommended in the use of the retractors exhibited. These narrow retractors would take up much less space than those surgeons had been accustomed to using. To enucleate the ganglion, he had usually employed blunt, curved scissors or a short-beaked, blunt hook. However, this dental instrument (the dental crowder, as he called it) seemed an ideal one, in that it was sharper and would enable one to do quicker work.

DR. CRILE, in closing the discussion said that in the case of brain anæmia, sensation was greatly lowered. Here Dr. Ochsner had made a distinct advance in the work from the point at which he left off.

Replying to the questions asked by Dr. Eisendrath, he said it was interesting to note that there was very little hæmorrhage after the clamp was taken off. The vessels were seen during the course of the operation, and after the removal of the clamps very little hæmorrhage ensued. The operative field was clean, so that one could pick up the vessels and tie them. He had never seen a case of cerebral embolism following the method he had described. However, if one squeezed the clamp or clamps too tightly, there might be the possibility of the formation of an embolus. Particularly would a thrombus be likely to be produced, and later embolism, if one were rough in his manipulations.

He had not for some time resorted to preliminary tracheotomy. He followed the teachings of some of his colleagues in putting patients in the upright position as early as possible after operations. He said he had a strong conviction that the foundation of a number of cases of septic pneumonia was laid at the time of the operation by too great exposure. When patients inhaled blood there was greater risk of septic pneumonia occurring. He was firmly convinced that with improved methods there were not as many cases of septic pneumonia now as formerly.

He would not make two operations at the same time in a case of cancer of the tongue, if he could avoid it. He would do the mouth operation first, possibly, and later on the operation on the neck. He would go low down in the neck, as he had pointed out in the demonstration.

As to whether or not, in an early case of cancer of the lip, he would make entire block dissection, he said he would not do so, but would do a regional block. In every case of superficial carcinoma he took out regionally, he had reason to believe that it was drained by the lymphatic area. He had this feeling, that as long as the glands of the neck were involved, no one knew or could tell in which direction the metastasis went, consequently when the glands were involved excision of at least half of the neck should be made.

In conclusion, he emphasized the point that it was much easier to do the larger operation than the smaller one.

COMBINED SUPERIOR TIBIOFIBULAR AND ASTRAGALOFIBULAR OSTEOPLASTY AS A MEANS OF PREVENTING SHORTENING OF THE LEG DURING ADOLESCENCE FOLLOWING EXTENSIVE OSTEOMYELITIS.

DR. NORMAN KERR read a paper with the above title, for which see page 425.

DR. A. J. OCHSNER said there was one feature in connection with the surgical treatment of osteomyelitis which was not so generally applied as it should be. In cases of acute osteomyelitis of the long bones, in which there was an apparent destruction of the entire shaft, the activity of the periosteum in the formation

of a new bone was stimulated to a greater extent by the presence of the old shaft than by anything else that could be done. Some eighteen or nineteen years ago Dr. Parkes demonstrated the fact that in acute osteomyelitis almost a normal limb could be secured in practically every case, provided the primary operation consisted in splitting the periosteum from end to end and leaving the shaft as an irritant for the formation of the involucrum which usually resulted in almost a perfect new bone.

DR. E. WYLLYS ANDREWS said that Dr. Kerr was to be congratulated on obtaining such a result in the case reported in a comparatively short time, as usually the results in such cases could only be secured in years, rather than months.

Operations for sequestrotomy must not be done too early. A great deal of interest attaches to the formation of an involucrum. This, when allowed to occur, insures proper length and support.

In this connection he would make a plea for the use of the Moorhof bone plug in cases where bone defects were to be filled. He thought there was nothing more advantageous than this plug in this and similar classes of cases. The materials of this bone plug mixture were iodoform, spermaceti, and oleum sesami. These ingredients were slowly heated to 100° C., and when allowed to cool would form a soft solid which would remain solid at the temperature of the body, and for use it was heated to 50° C., being constantly stirred to keep the iodoform evenly distributed. This material would fill a cavity in bone just as well as the dental surgeon filled a cavity with amalgam. The wound could be closed over it. There would soon be the formation of new bone, gradually displacing the plug, and primary healing of the wound.

CONGENITAL ATRESIA OF THE ILEUM.

DR. WILLIAM HESSERT exhibited a specimen removed from an infant, five days old. The history, as given by the mother, was that the baby had not had a bowel movement since birth, and the attending physician had informed him that at birth there was no escape of meconium. The patient showed the typical symptoms of intestinal obstruction—vomiting, distended abdomen, and was in a low condition. On opening the abdomen,

dilated coils of intestine presented, and in following them down he found that the ileum ended below in a blind pouch. It was much larger then than it was now. It was filled with fæces to almost the size of one's fist. There was no connection between the ileum and the colon. The ileum ended in a blind pouch, and the colon was to the right, greatly contracted. It was impossible to make any sort of anastomosis between the ileum and colon. He opened the blind pouch, allowed the gases and fæces to escape, and then sutured it to the abdominal wound. The child died the next day. He presented the case as a pathological curiosity.

BOOK REVIEWS.

GALL-STONES AND THEIR SURGICAL TREATMENT. By B. G. A. MOYNIHAN, M. S. (London), F. R. C. S., Senior Assistant Surgeon to Leeds General Infirmary, Leeds, England. *Second edition, revised and enlarged.* Octavo, 458 pages. Philadelphia and London. W. B. Saunders & Co., 1905.

That a book devoted exclusively to the consideration of the diseases produced by gall-stones should in little less than a year require a second edition is sufficient evidence both of the value of the work and the interest of the profession in the subject. Needless to say, the author has discussed the questions involved with clearness and force. The book is well printed, and the illustrations excellent, particularly the half-tones and colored plates. A valuable chapter on congenital abnormalities of the bile-tracts has been added to this edition. The exposition of the operative technique is lucid and clearly illustrated. The chapter on the symptoms and signs of gall-bladder disease is especially valuable and complete, and ought of itself to give this volume a place not only on the shelves of the surgeon, but on those of the general practitioner and internist as well.

A. T. BRISTOW.

SURGICAL DIAGNOSIS. A Manual for Practitioners of Medicine and Surgery. By OTTO G. T. KILIANI, M.D., Surgeon to the German Hospital, New York. William Wood & Co., New York. 1905.

The purpose of the present work is to educate the physician to differentiate between medical and surgical cases, or, in other words, to assist the practitioner in deciding the difficult question whether or not a disease needs surgical interference.

The introductory chapter deals with the methods of examination and injuries and wounds in general. This chapter, which occupies only 25 pages, is altogether too elementary as an introduction to such a work. It lacks system and complete-

ness, and leaves the reader poorly equipped to understand that which follows.

The author takes up the injuries and diseases of the various organs and tissues of the body, the special parts being arranged in anatomical order, beginning at the head.

Each chapter deals with a special part of the body. The various surgical conditions which may arise are described, detailing in a few words the etiology, symptoms, diagnosis and differential diagnosis of each injury or disease, and further stating the indications and contraindications for operation, and the results to be expected from surgical interference.

The book is not written for the surgeon, but for the general practitioner. The author assumes that the physician already knows medical diagnosis, and does not burden him with facts and theories which are already at his command in the works on medical diagnosis. Accepting the book in this light, the work will find a wide sphere of usefulness.

PAUL PILCHER.

THE SURGICAL TREATMENT OF CHRONIC SUPPURATION OF THE MIDDLE EAR AND MASTOID. By SEYMOUR OPPENHEIMER, M.D., of New York. P. Blakiston's Son & Co., Philadelphia.

A very comprehensive treatise of 425 pages, beautifully printed and illustrated on good paper and well bound, apparently intended as a companion volume to Whiting's "The Modern Mastoid Operation," by the same publishers.

The following points receive especial emphasis: The prohibition of the use of the galvano-cautery in the depths of the external auditory canal or in the tympanic cavity; the hazard attending removal of masses of granulation tissue springing from the tympanic roof; the trial of persistent and thorough local treatment before recommending the more serious surgical attacks; the doing of ossiculectomy, as a rule, before deciding as to the necessity for a radical operation on the mastoid process; the use of adrenalin chloride to control the bleeding in ossiculectomy; the caution against interference with the stapes in suppurative cases; the fact that the conservation of the functional ability of the ear is to be considered unless there is danger

of the extension of the suppurative process, when, of course, the more important indication is to forward good drainage. The author advises prolonged after-treatment, in cases in which ossiculectomy has been done, before entertaining the belief that the radical operation is unavoidable. He also states that "it is very well proved . . . that we can obtain little or no evidence of any practical value" "by the external appearance of the mastoid exterior, so that one can avoid the lateral sinus," etc., p. 190; also that "the cranial cavity is never lower than the spina" (supra-meatum), p. 196; also that "the simple opening of the mastoid process, without entering the antrum, has no place at all in the treatment of chronic aural suppuration," p. 238. He does not favor primary closure of the mastoid wound nor Blake's blood-clot method. He says truly that "the radical operation . . . is only relatively so, as it may be impossible to remove all the diseased tissue that may extend to the finer cellular spaces," p. 280. He fails to note the fact that the facial nerve may take an abnormal course through the mastoid process and elsewhere.

The author describes the various classical operations and the numerous methods of forming flaps to cover the wound in the bone. He has brought together much matter largely collated from the more recent writers.

HENRY A. ALDERTON.

MINOR AND OPERATIVE SURGERY, INCLUDING BANDAGING.

By HENRY R. WHARTON, M.D. Sixth Edition. Lea Brothers & Co., Philadelphia and New York. 1905.

This volume of 650 pages is the sixth edition of a surgical text-book which has enjoyed such popularity as to call for three new editions since 1901, at which time the third edition was reviewed by the writer in the June number of the *ANNALS OF SURGERY*. Its title has been changed from "Minor Surgery and Bandaging" to that which appears above. This has been done because of a broadening of the scope of the work so as to include descriptions of many surgical procedures which are far beyond the realm of so-called Minor Surgery. The chapters on Bandaging, Asepsis, Fractures, Wounds, Sprains, Anæsthetics,

X-Rays, etc., have been enlarged and revised so as to meet the requirements of surgical progress. To the last section there have been added descriptions of those operations which are most commonly practiced both by the student on the cadaver and the general hospital surgeon. Here include Ligation of Arteries, Amputations, Operations on Nerves and Tendons. Excision of Joints, Tracheotomy, Intestinal Anastomosis, Appendicitis, Strangulated Hernia, etc.

The book is profusely and well illustrated.

WALTER A. SHERWOOD.

A COMPEND OF OPERATIVE GYNÆCOLOGY. By WILLIAM SEAMAN BAINBRIDGE, M.D., Adjunct Professor of Operative Gynæcology on the Cadaver, New York Post-Graduate School and Hospital. 12 mo. Pp. 76. The Grafton Press, New York City.

In this book the various operations of gynæcology are described concisely, with special reference to their practical relations. It has been planned more especially for the help of post-graduate students in following the author's course of operations upon the cadaver. Various abdominal operations are included in the scope of the work, the view of the author being that the gynæcologist is an abdominal surgeon, who should be able to cope with any abdominal condition that might be met with. The book contains many admirable suggestions, and is interesting especially as an index to the field and methods of the author's instruction.

LEWIS S. PILCHER.

A TREATISE ON THE DISEASES OF INFANCY AND CHILDHOOD. By HENRY KOPLIK, M.D., Pediatricist to Mt. Sinai Hospital, New York. New Second Edition. Revised and Enlarged. Lea Brothers & Co., Publishers, Philadelphia and New York. 1905.

Dr. Koplik has produced a most excellent treatise on the diseases of infancy and childhood. It embraces as well a consideration of the physiology and pathology of the new-born, and the management of infant feeding.

The advances in the field of pediatrics in the last few years have been most striking, and although the author does not quote to any extent from other works, yet he has evidently kept in touch with the work of others. The present book reflects very largely the personality of the author, rather than the concensus of opinions of other workers in this field. He advocates the Rotch method of percentage feeding.

His book is written so as to be equally useful to the country and city physician, and describes clearly the methods of home modification of milk as carried out both in the country and the city districts.

The clinical character of the work has been preserved throughout, and as a treatise on the diseases of children, and their proper management, Dr. Koplik has produced a most practical and scientific work which will be acceptable alike to students and physicians.

PAUL M. PILCHER.

CLINICAL APPLIED ANATOMY OR THE ANATOMY OF MEDICINE AND SURGERY. By CHARLES R. BOX, M.D., B. S., M.R.C.P. (Lond.), F.R.C.S. (Eng.), W. Mc ADAM ECCLES, and M.S. (Lond.). F.R.C.S. (Eng.). Illustrated. P. Blakiston's Son & Co. Philadelphia. 1906.

This work differs from most of the text-books on applied anatomy in that it deals almost exclusively with the clinical side of the subject and is written from the view-point of the practitioner of medicine and surgery rather than that of the anatomist. As is stated in the preface, the authors have attempted to follow the lines suggested by John Hilton in his classical treatise on "Rest and Pain," which was published in 1862. The important influence of anatomy on the occurrence and course of disease and injury is well illustrated. Purely surgical anatomy, which is detailed in the various text-books on operative surgery, is purposely omitted.

There are twenty chapters in all, the first ones being given to the consideration of Inflammation, Tuberculosis, Syphilis, Gangrene, and the specific fevers. Then follow chapters on Tumors, Fractures, Dislocations and Diseases of the Bones,

Joints, Muscles, Tendons and Bursæ. The remaining sections include diseases of the nervous, vascular, lymphatic, respiratory, digestive and genito-urinary systems, diseases of the ductless glands, the eye and the ear.

The chapters on diseases of the nervous and vascular systems are the most complete.

The entire work is well written and gives expression to many original ideas. The book is illustrated by means of forty-five plates, twelve of which are colored.

WALTER A. SHERWOOD.

CORRESPONDENCE.

REMOVAL OF HEMORRHOIDS BY EXCISION AND SUTURE.

TO THE EDITOR OF THE ANNALS OF SURGERY:

YOUR article as it appears in the August issue of the ANNALS OF SURGERY describing an original operation for hemorrhoids, has attracted my attention. In the *British Medical Journal* for February 28, 1903, A. B. Mitchell describes an original technic for this operation. I can see very little difference in his operation and yours; indeed, they are similar in every respect save one: you incise the mucocutaneous border before applying the forceps, he does not.

The simplicity and effectiveness of Mitchell's operation attracted me when it appeared, and I have resorted to it in many instances. It is followed by less pain, shortens convalescence, and there are no tags or irritable fissures left. In one instance, however, I had hemorrhage which the continuous suture did not control.

I take the liberty of calling your attention to this operation, for it is another illustration of how two surgeons acting independently may devise the same technic; and it appears to me that some acknowledgement should be made of Mr. Mitchell's work.

Yours very truly,

RICHARD DOUGLAS.

NASHVILLE, TENN., August 14, 1906.

CHEWING-GUM AND HAM-RIND AS NUCLEI OF VESICAL CALCULI.

TO THE EDITOR OF THE ANNALS OF SURGERY:

THE case of chewing-gum nucleus of a vesical calculus reported by Dr. E. B. Kenner in the August issue of the ANNALS OF SURGERY has brought to my mind a similar case under my own observation some years ago which has never been reported.

I venture to report it now as a contribution to the general subject of foreign bodies introduced per urethram into the bladder.

In 1892, in the month of July, a man came to me complaining of vesical irritation. He was suffering not only from an increased desire to urinate but the act was accompanied and followed by pain. The pain during the act was located in the glans penis; that following was located over the bladder. There was a little elevation of temperature. The constitutional symptoms however were not marked. The trouble had arisen quite suddenly. Examination of the urine showed some mucus and blood. No adequate explanation of the condition could be found. The sound failed to show the presence of calculus, and he had no discharge from the urethra, nor had he ever had gonorrhœa.

Treatment for a cystitis of unknown origin was instituted and failing to improve sufficiently in a few days he passed out of my care for several weeks. Then he returned in worse condition than he was before. Sounding at this time gave positive evidence of stone and he finally agreed to operation. Through a median perineal incision a phosphatic calculus was removed, the nucleus of which was a mass of white wax chewing-gum. He made a good recovery.

He then confessed that this chewing-gum had been introduced only a few days before he began to suffer from it. His admissions and peculiarity of manner proved him to be a sexual pervert.

On June 8, 1902, he again presented himself and without any attempt to deceive me related that while introducing a piece of meat into his urethra it had gotten beyond his control and he could not get it out. He insisted that it was yet in the canal, that he could feel it and that if he had a pair of forceps he could get it himself. Examination proved him to be mistaken in this and he was sent to the hospital, where a suprapubic cystotomy was immediately done and the meat extracted. It proved to be a piece of the rind of ham four inches long and almost as large as the little finger in appearance!

B. VAN SWERINGEN, M.D.

FORT WAYNE, IND., August 11, 1906.

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ORIGINAL MEMOIRS.

FILARIASIS.

BY JOHN H. CUNNINGHAM, JR., M.D.,

OF BOSTON,

Surgeon to the Long Island Hospital, Boston, Mass.

FILARIASIS is an endemic parasitic disease of surgical interest because of certain local manifestations produced by the parasites in the lymphatic system which may be benefited by surgical measures.

Manson, whose work upon this subject has extended over a period of twenty years, states that there are four well-known nematodes which inhabit the circulation, and that there are probably other species. He gives the following nomenclature: The original filarial embryos, described by Lewis, are the ones which concern us here, and have been given the name *Filaria nocturna*. The other filariæ he has termed *Filaria diurna*, *Filaria perstans*, and *Filaria Demarquaii*. Two doubtful species he gives the names of *Filaria Ozzardi* and *Filaria Magallhaesi*. Prout has recently described another blood-worm under the name of *Filaria gigas*.

No pathological importance is attributed to any of these parasites except to the *filaria nocturna*, which is the embryonic form of the adult worm *Filaria Bancrofti*, whose natural habitat is the lymphatic system of man.

Filarial disease occurs endemically in tropical and sub-tropical countries, and is prone to exist along the seacoast and large rivers. The origin of the sporadic cases, occasionally encountered in the colder climates, can usually be traced to one of the following geographical regions: India, Ceylon, China, the Malay Archipelago, Japan (particularly the most southerly islands), Egypt, East Africa (especially along the coast of Zanzibar), Mombasa and Tanga, the West Coast of Africa, Senegambia, Madagascar, and Orange River Colony (Bloemfontein), Reunion, Mauritius, Australia (Queensland), New Caledonia, the South Sea Islands, Guiana, Brazil, United States of Colombia, West Indies, and Spain.

In the filarial districts a large proportion of the population is affected by the disease. In Amoy (China) Manson found one-eighth of the population affected. Thorpe found twenty-five per cent. of the natives of the Fiji Islands affected, and thirty-two per cent. of the Friendly Islands. In southern India, in the districts of Travancore and Cochin, Underwood reports one-tenth of the whole population as afflicted. Koni-ger states that fifty per cent. of the male population of Samoa have filariasis. According to Saville seven-tenths of the adult males of the island of Huahine, one of the Friendly group, suffer from the disease.

Vincent tabulates five hundred cases taken indiscriminately from among patients at the Colonial Hospital, Port of Spain, and St. Anne's Lunatic Asylum, and from private sources. The percentage of blacks with filariasis was 4.9, of whites 10.9, and of East Indians 2.4. The percentage of infection in the case of the whites is strikingly high. The white population of Barbadoes and Demarara show a high percentage of infection, and in Trinidad, 14.5 per cent. of the white population are infected with this disease.

Indigenous cases in the southern part of the United States are on record. De Saussure, in 1890, reported twenty-two cases that he had observed in Charleston, S. C. Slaughter, in 1891, reported two indigenous cases in the northern part of Virginia. Mastin, in 1888, found such a case in Mobile, Ala..

and Dunn has demonstrated filaria embryos in a woman who has always lived in Pennsylvania. Guiteras, in 1886, called attention to the presence of the disease in the southern states, four in Key West and one in Charleston, S. C. Cases occurring in the seaport towns can be explained by the constant communication with the filarial districts, but the origin of the indigenous cases is more difficult to understand.

The following case, a native of the United States of Colombia, was referred to me by Dr. C. H. Le Franc, of Cartagena, in May, 1904:

D. M., 35, M. Merchant; Spaniard; South American born.
Family History.—Excellent.

Past History.—No severe illnesses. Gonorrhœa three times. last attack twelve years ago. No complications or sequelæ.

Present Illness.—In 1885 the patient had a severe attack of "chills and fever" which confined him in bed for two days. Associated with the fever there was moderate swelling of the scrotum and severe pain in the lumbar region. Nothing abnormal regarding the urine was noted. The "chills and fever" ceased in a few days, but the swelling of the scrotum persisted in slight degree. There was a similar attack once every year until 1892, when the pain in the back was much more severe and the urine became bloody. The scrotum at this time was the size of a cocoanut, and bunches, the size of the fist, appeared in each inguinal region. The "chills and fever" continued about four weeks, during which time the patient was confined to bed. As the "chills and fever" subsided, the swelling in the scrotum disappeared, and those in the groin diminished in great part. Diarrhœa was profuse at this time. The hæmaturia continued for three months. During this attack of hæmaturia he came to Boston and saw Dr. Arthur Cabot, who found filarial embryos in his blood.

The attack the following year, 1893, was less severe and he had no associated hæmaturia or diarrhœa, although the scrotum was abnormally large and the tumors in the inguinal region became enormously swollen. In 1894 there was again hæmaturia lasting one month. The pain in the back was severe at this time.

These attacks of chills and fever and swelling of the scrotum

without further hæmaturia occurred once yearly until 1902, during which year he had three attacks of the same character already noted, associated with severe diarrhœa. At no time did the patient pass chylous urine. There was no frequency of urination, or difficulty or pain in performing the act except during the attacks of hæmaturia, at which time the passage of small blood-clots caused considerable pain.

The scrotum has remained swollen between the attacks, and there has been considerable pain in the region. There has also been constant dull lumbar pain. The scrotal pain was constant, of a dull, heavy dragging character, and was aggravated by walking or riding, and for which he has worn a supporter since 1892. It has been necessary for him to give up horseback riding for the last few years, on account of pain of a severe, sickening character radiating from the perineum into the epigastrium, causing him to become nauseated.

The patient states that he has suffered from melancholia for the past seven years, but there is no definite history pointing to this mental disturbance.

Dr. Le Franc states that when the scrotum and inguinal regions were acutely enlarged he believed there was fluid in the tunica vaginalis. The swellings subsided with the application of hot fomentations.

Physical Examination.—Well developed and nourished. Dark complexioned. Heart and lungs normal. Abdomen full, lax, tympanitic, not tender. Liver area normal, not felt. Spleen not felt; area not increased. Neither kidney palpable. Fulness throughout the course of both inguinal canals, producing an elongated swelling slightly more on the right than left, about one inch high and two inches wide, extending from the scrotum to the internal abdominal ring. These swellings are firm, but not hard, tender, or movable. They are deeply situated and continue into the scrotum along the spermatic cord. The scrotum is enlarged downward and laterally and appears distended by masses within. It is slightly fuller on the right than on the left side. Palpation shows a mass somewhat larger than the fist in the right upper quadrant; it is continuous with the mass in the right inguinal region and resembles a varicocele to the touch. This is continued downward along the course of the spermatic cord.

The vas deferens is clearly defined posteriorly. The right testicle is displaced into the perineum about one inch below the scrotum, and perineal junction. It is easily replaced into the scrotum, but drops back immediately when not held.

A similar but smaller mass is present in the left upper quadrant of the scrotum, which also continues downward along the spermatic cord, from which it is easily differentiated posteriorly. The cord on this side is slightly lengthened and presents the same character as that on the other side, and the testicle, which like its mate is normal in size and shape, is situated a little lower than normally.

The external inguinal ring on both sides, although only admitting the tip of the index-finger, because of continuation of the masses already noted into the inguinal canals, are considerably enlarged. There is no impulse or expansion of the masses on cough.

The skin of the scrotum is not thickened nor otherwise abnormal in character. No fluid is demonstrable in the tunica vaginalis, either by palpation or by the hydroscope. The cremasteric reflexes are equal and lively. The scrotum is diminished about one-third in size when the patient is lying flat. It is also diminished by the application of cold. The urethra admits a 27 *bougie à boule* to the triangular ligament and no obstruction is met in withdrawing it. The sound, 27 F., is passed into the bladder without meeting obstruction or deviating from a median line.

The *rectal examination* shows the prostate to be normal in size, shape and contour, with a distinct median raphe. Both seminal vesicles are normal by palpation.

Extremities normal. Reflexes equal and lively. No general or local glandular enlargement.

Urine Examination.—Color normal; sp. gr. 1014; acid; no albumin, bile or sugar; urea 2.8; cryoscopic freezing point 2.1; no apparent sediment. Centrifugalized urine shows no cells or casts. Occasional normal blood-corpuscles. A few sodium urate crystals. No embryo filaria found in many examinations at different times of day and night.

Blood Examination.—The blood examinations at different times are as follows:

May 12, 1904 (3 P.M.).—White cells, 5,200. Red cells, 5,640,000. Hgb. 90 per cent. No filariæ.

Differential count of 100 cells:

Lymphocytes	38.
Mononuclear leucocytes	4.
Polynuclear leucocytes,	51.5
Eosinophiles	6.5

May 14, 1904 (4 P.M.).—White cells, 5,600. Red cells, 5,600,000. Hgb., 90 per cent. No filariæ.

Differential count of 100 cells:

Lymphocytes	36.
Mononuclear leucocytes	6.
Polynuclear leucocytes	50.5
Eosinophiles	7.5

(12 Midnight).—White cells, 11,5000. Red cells, 5,102,000. Hgb., 90 per cent. Many filariæ.

Differential count of 100 cells:

Lymphocytes	40.
Mononuclear leucocytes	6.
Polynuclear leucocytes	35.5
Eosinophiles	18.5

May 16, 1904 (3 P.M.).—White cells, 5,4000. Red cells, 5,120,000. Hgb., 95 per cent. No filariæ.

Differential count of 100 cells:

Lymphocytes	30.
Mononuclear leucocytes	4.5
Polynuclear leucocytes	60.
Eosinophiles	5.5

(11 P.M.).—Many filariæ.

Differential count of 100 cells:

Lymphocytes	45.
Mononuclear leucocytes	4.5
Polynuclear leucocytes	31.5
Eosinophiles	19.

May 18, 1904 (3 P.M.).—Examination by Dr. Pratt:

Erythrocytes	5,504,000
Hæmaglobin	100 per cent. (Sahli).
No leucocytosis	

Differential count of Leucocytes	Percentage.
Eosinophiles	7.1
Polynuclear leucocytes	52.2
Lymphocytes	37.
Large mononuclear leucocytes	3.3
Mast cells4
	100.0

292 leucocytes counted.

(12 Midnight).—White cells, 12,600. Many filariæ.

Differential count:

Lymphocytes	36.
Mononuclear leucocytes	6.
Polynuclear leucocytes	37.5
Eosinophiles	20.5

June 7, 1904 (11 P.M. 18 days after operation).—White cells, 5,000. Red cells, 5,280,000. Hgb., 100 per cent. No filariæ found.

Differential count:

Lymphocytes	28.
Mononuclear leucocytes	4.5
Polynuclear leucocytes	62.5
Eosinophiles	5.

Patient was seen in consultation by Dr. Abner Post and Dr. Joseph H. Pratt.

Operation.—May 20, 1904. Ether. Incisions about eight inches long, extending from the internal abdominal ring downward over the anterior surface of the scrotum along the course of the spermatic cord. The masses previously noted were found to be enormously enlarged lymphatics, and to a less extent dilated veins of the spermatic cord. As these continued into the inguinal canal, the fascia of the external oblique muscle was incised up to the internal abdominal rings. The vas deferens on both sides were dissected from the enormously dilated lymphatics, leaving a small amount of adjacent tissue for blood supply. The testicles, normal in every respect, were left attached to the vas of their respective sides. The cords, however, were ligated at a point about three-quarters of an inch above the epididymis. A clamp was applied about one centimeter above the tie and the cord cut between, with a small escape of chylous fluid, which was caught on swabs for examination. The masses were somewhat diminished in size as they disappeared into the abdomen through the

internal abdominal rings. These were transfixed at this point and tied. The mass was clamped just below the tie and cut between, with an escape of chylous fluid as before.

The testicles were then attached, by a mattress suture passed through the cut end of the cord, to a septum of the scrotum on either side, so that they assumed a normal position. The vas deferens on each side was placed in its normal position in the inguinal canal and the fascia of the external oblique muscle was sutured by continuous chromic gut sutures. The superficial fascia was sewn in a like manner, and the external wound brought together by silkworm-gut sutures, while the scrotum wound was sewn by continuous chromic gut. A dry sterile dressing and a T-bandage were applied, with the scrotum elevated. Duration of operation one and one-half hours.

The patient took ether badly throughout the operation, frequently hiccoughing. About fifteen minutes after being removed from the table the patient, although having had a pulse of about 110 throughout the operation, was found to be pulseless. Strychnia, one-thirtieth of a grain, was given subcutaneously. Heaters, blankets and elevation of the foot of the bed failed to produce a pulse of such a character that it could be counted. The patient was given three shock enemas consisting of coffee, brandy, and salt solution, at intervals of one-half hour. These did not materially improve his condition.

His skin and mucous membrane were blanched, and as he came out of the ether he was very restless, desired to be fanned, was very thirsty and complained of a sense of oppression. This, together with a barely perceptible pulse, pointed strongly toward hæmorrhage. Examination of the wound two hours after operation failed to reveal anything other than a slight ooze. Percussion of the abdomen gave no signs of internal hæmorrhage except for dulness in the left flank, which did not move with change of position, and which might well have been the retained shock enemas.

The patient was given fifteen minims of tincture digitalis intra-muscularly every three hours, and received one litre of normal saline solution under the breast, about two and one-half hours following operation. The condition certainly suggested internal hæmorrhage, and, although special care was taken in

tying off the spermatic cord, it was feared that bleeding was taking place from one of these stumps. However, operative interference was absolutely contraindicated on account of the patient's low condition. At the end of eight hours his condition remained practically the same, which fact, together with the knowledge of his condition immediately following operation, pointed less strongly toward hæmorrhage, the classical and technical signs of which still remained.

He was blanched and restless. Respiration 60 a minute. Temperature, 94° . Semi-conscious, feebly requesting water and air. Ten hours following operation the pulse became of slightly better quality, although it was still too rapid to be counted. From this time on his pulse gradually improved in quality, and the following day ranged between 150 and 160, but was decidedly thready in character. Forty-eight hours following operation the pulse had reached 120 and was of better quality; the temperature had jumped to 100.5° , and his general condition was fair, although he still remained blanched.

The patient improved slowly from this time, and one week following the operation the pulse was 80, of good volume and tension, and the respirations and temperature were normal.

The wounds healed by first intention and the stitches were all removed on the tenth day. The patient was up on the twentieth day following operation, and was discharged from the hospital June 9, 1904.

The blood was examined several times for filariæ beginning twelve days after operation, but none were found.

The day following discharge from the hospital the patient noticed a small swelling in the upper part of the left wound. It was not tender and presented none of the signs of inflammation except a slight sense of fluctuation. A small incision was made into the mass, and about a half dram of a greyish gelatinous substance was obtained. Under the microscope this substance was found to be necrotic tissue. No evidence of a suture could be found, and nothing resembling any part of an adult filaria was seen. The wound was dressed twice daily for six days, at the end of which time only a slight granulating area remained, and the patient returned to South America.

Word occasionally received from Dr. Le Franc informs me

that the patient has had no return of his symptoms, and that the embryos remain absent from the blood. On September 27, 1905, Dr. Le Franc stated that the patient had become the father of a child and that he had expressed himself as being much improved sexually since the operation.

In a letter received from the patient himself in January, 1906, twenty months after operation, he states that he considers himself entirely cured of his trouble.

The Specimen.—The mass of tissue removed from the *right side* is 24 cm. long. The lower end shows several small vessels cut across. The diameter at this point is 2 cm. The upper end, similar in structure, measures 2 cm. in diameter. From both ends the mass increases in size and the central point is ovoid in shape. This enlarged area measures 12 cm. x 6 cm. x 3 cm., and is made up of tortuous vessels from 1 to 5 mm. in diameter, resembling a varicocele. These vessels are surrounded by loose areolar tissue. The contents of these vessels is chylous.

The specimen from the *left side* is 21 cm. long and 4 cm. at its greatest width. Like the specimen of the right side, it consists of tortuous lymphatic vessels and areolar tissue, and two of the vessels can be traced the entire length of the mass. They measure 7mm. in diameter, and the walls are 1 mm. in thickness.

The tissue was placed in normal salt solution and kept in a thermostat for several hours, but the worms did not appear.

The two masses of tissue were examined microscopically by Dr. S. B. Wolbach, of the Harvard Medical School. The tissue was divided into slices, about 1 cm. thick. Every other slice was embedded in celloidin, and stained with hæmatoxylin and eosin. Twenty-eight blocks in all were examined.

The microscopic sections consisted of loose connective and fat tissue, with many thick-walled arteries and veins, some of which are obliterated by connective tissue. There is a marked lymphoid and plasma-cell infiltration in the connective tissue surrounding the capillaries and veins. There are numerous dilated lymphatics in the fat and perivascular tissue. There is a slight general infiltration of the connective tissue with lymphoid and plasma cells. No filariæ were found in the tissue examined.

It has been suggested by Dr. Wolbach that the worms may have escaped with the chyle which was emptied from the lymphatic directly after the operation.

History.—Certain manifestations due to the *filaria sanguinis hominis* received the attention of Arabian medical men as far back as the ninth and tenth centuries. The chief manifestation of which we have record was elephantiasis, which is the Greek translation of the words *Da-al fil*, meaning elephantine disease.

Chapotin, in 1812, had recognized endemic hæmato-chyluria and communicated his knowledge in writing to Mauritius.

Nothing was known of the etiological factor producing these various manifestations until 1863, when Demarquay, in Paris, first discovered the *filaria nocturna* in a chylous fluid obtained by tapping a hydrocele in a young man, a native of Havana.

In 1868, Wucherer, in Bahia, Brazil, found filarial embryos in chylous urine.

In 1868, Lewis, in Calcutta, also observed filarial embryos in chylous urine, and demonstrated them in the blood of a patient with chronic diarrhœa. He subsequently found the parasites in the blood and lymphatic secretions of individuals with elephantiasis of the legs and scrotum, and in the blood of persons presenting the symptom hæmaturia, and considered the parasite to be the cause of these various manifestations. Lewis demonstrated the *filaria* without any knowledge of the previous discoveries, and gave the hæmatozoon the name of *filaria sanguinis hominis*.

It had been observed that the *filari* did not grow to the adult worm in the human body. In 1878 Manson discovered that the mosquito was the intermediate host in which the embryo matured to the adult worm and then invaded man anew. He found that the *filaria* embryos were ingested with the blood by the female mosquito (the male having no sting), and were developed in the stomach. Some of the embryos were digested, others slipped from their sheaths and bored through the walls of the stomach, invading the muscles of the thorax, undergoing a metamorphosis, requiring two or three weeks until they were transformed into an actively mobile

worm. He believed that matured eggs were deposited in stagnant water and that the filaria entered the human body in drinking water.

Bancroft found that the larvæ could not live in water, dying in from three to four days. His idea was that infection occurred by swallowing mosquitoes containing larvæ while asleep, with food, or the mosquito being killed, the filaria was transferred to the mouth by means of the fingers. He also believed in the transmission of the disease through the sting of mosquitoes.

Myers, to determine the truth of Manson's idea, fed monkeys with water in which mosquitoes fed upon the blood of filarial patients had laid their eggs. The results were negative.

Vincent, in 1895, proved by careful experiments that when the mosquito falls into the water, the filariæ, if unable to escape, die in twenty-four hours by imbibition, and in another series proves that the filaria does not pass from the living mosquito in the act of suction of water.

Lewis confirmed Manson's observations that the filaria larvæ pierced the walls of the mosquito's stomach and experienced developmental changes in the abdominal and thoracic tissue. Low demonstrated that the filariæ migrated to the head and proboscis of the mosquito and inferred that the parasite enters human tissue when the insect stings an individual.

Manson deserves the credit for our knowledge of the *life history and periodicity* of the parasite. He demonstrated that the embryos were present in the peripheral circulation during the night, and considered this periodicity to be an adaptation to the habits of the mosquito.

Mackenzie pointed out that if the patient slept by day and worked by night the habit of the filariæ reversed and they were present in the peripheral circulation during the day and not during the night. His observations were made by examining the blood every three hours during the day and night for a period of ten weeks.

The periodicity cannot depend entirely upon the sleeping state, as the embryos can be demonstrated between five and six

o'clock or several hours before the patient retires. The number in the peripheral circulation increases, reaching a maximum about midnight, when from 300 to 600 are found in every drop of blood, which, assuming that the parasites are evenly distributed throughout the circulation, shows that there are from forty to fifty millions in the circulation at that time. The number gradually decreases from midnight, and they usually disappear entirely by eight or nine o'clock in the morning.

It is evident, therefore, that the sleeping state is not the cause *per se* of the increase in the number of parasites in circulation. The ingress begins several hours before the usual time for sleep and the egress is not complete until several hours after the usual time for waking. Further study may reveal a reasonable explanation for filarial periodicity.

In 1899 Manson demonstrated that when the filariæ are absent from the peripheral circulation they may be found in the larger blood-vessels of the lungs, and less frequently elsewhere. His observation was made upon a patient suffering from lymphscrotum and varicose inguinal nodes. This patient committed suicide in the morning by swallowing hydrocyanic acid, death occurring almost instantly. A post-mortem examination six hours later revealed a large lymphatic varix occupying the pelvis and the back part of the abdominal cavity. In this varix, adult filariæ Bancrofti were found. The embryos were noted to be most numerous in the large blood-vessels and in the lungs. They were also found in the liver, spleen, and heart muscles.

The Adult Filaria Bancrofti.—The adult filaria Bancrofti belongs to the nematodes, and was first discovered by Bancroft, of Brisbane, Australia, in 1876, in a lymphatic abscess on a patient's arm. In 1877 Cobbold published the fact and named the nematode the filaria Bancrofti.

The adult filaria, first found by Bancroft in 1878, has since been found by various observers. The adult filaria, however, has been found only in a very small percentage of the cases suffering from filariasis. In 1877 Lewis found a portion of a male and female worm in a blood-clot from a

lymphscrotum, after searching eight hours. In 1877 Des Santos, in Brazil, found five adult females in a lymphatic abscess of the arm. In 1881 Manson found a few fragments of a female worm in an abscess of the thigh, and in the same year demonstrated a female filaria in the dilated lymphatic in a case of lymphscrotum. In 1888 Sibthorpe of Madras, India, found two worms, a male and a female, on the cut surface of a lymphscrotum. In 1894 Maitland, of Madras, India, obtained eight adult worms in lymphatic tissue removed from the inner surface of the upper arm in two operations; three were males and five females. Huber states that Czerny found a living female filaria in the ovary of a woman from Rio Janeiro. In 1897 Young, in London, removed a hard, nodular mass from a sailor, a native of Jamaica, who suffered from lymphscrotum, and varicose groin glands. This man committed suicide, and at autopsy the right varicose groin-glands were found to contain three female filaria Bancrofti. In the lymphatics of the right spermatic cord six more adult female worms were found. In the left spermatic cord seven worms were found, one being a male. In 1890 Lothrop and Pratt found nine worms, two males and seven females, in the lymphatics of the epididymis, following castration for filariasis. In 1903 Opie found an adult worm in the right epididymis, at autopsy. Primrose, in 1903, obtained an adult filaria and several fragments in an operation for lymphscrotum.

Taniguchi records four cases in which the adult worms were found. One case was a male suffering from inguinal lymphvarices. Two adult worms were recovered at operation. His other case was a woman who had several small nodes in the breast. At operation several adult filariæ Bancrofti were found. The remaining two cases recorded by Taniguchi belonged, one to Ikeda, and the other to Kumono. Both these cases were operated upon for inguinal lymphvarices and lymphscrotum and the worms were found in each instance. The number and sexes are not recorded.

It is seen, from the above, that the female is much more commonly found than the male worm, and that the location

in fifteen out of the nineteen cases was in relation to some part of the generative system: Lymphscrotum (Lewis, Manson, Bibthorpe, Primrose, Taniguchi, Ikeda, Kumono), chylocele fluid (Bancroft), epididymis (Lothrop and Pratt, Opie), ovary (Czerny), spermatic cord (Young); arm (Bancroft, Maitland, Young, and dos Santos), leg (Manson), breast (Taniguchi).

The adult parental forms of the filaria Bancrofti are long, hair-like, transparent nematodes, from three to four inches in length. The male and female are often found coiled about one another, within dilated lymphatics and the lymphatic glands themselves.

The female is considerably larger than the male, and measures from 8.5 to 9.5 cm. in length, and is the thickness of a human hair. Macroscopically the worm is a small, slender, delicate, whitish, hair-like body. Microscopically the head is rounded, with an unprotected oral orifice. The tail, which is slightly tapering, has an abrupt end. The anal aperture is situated just in front of the termination of the tail, while the sexual openings are near the head. The digestive tract is a simple tube, and the remainder of the body is occupied by the sexual organs. Manson states that the worm is normally viviparous, but that the eggs are sometimes prematurely deposited so that it becomes oviparous.

The male worm is shorter and slenderer and has a marked disposition to curl. Daniels gives his length as 4.4 cm. Manson describes two slender unequal spicules originating at the cloaca.

Embryos.—The embryos are found in the peripheral circulation as delicate, translucent, smooth, almost cylindrical bodies. The head end is rounded and the caudal extremity is pointed. Scheube states the average length to be 0.216 mm. and the breadth 0.004 mm. The parasite is enveloped in a transparent sheath which is longer than the embryo, and which is sometimes seen trailing after the head or tail, or both. The embryo has been observed to move about within its sheath. When studied in freshly-drawn blood the movements are con-

tinuous, but not those of progression. The tail whips from side to side actively amongst the blood corpuscles. It writhes and coils with much activity. The embryos remain alive for several days if the preparation is prevented from disintegration.

Under high magnification there is an irregular granular mass observed at the posterior part of the middle third of the parasite, and a very delicate transverse striation can be detected throughout the entire length of the embryo. By staining with a mild solution of hæmatoxylin Manson has demonstrated a V-shaped patch at a point of about one-fifth the entire length of the organism, backward from the head end, and a similar spot, though smaller, situated a short distance from the end of the tail. The former of these he terms the "V spot" and the latter the "tail spot," and considers them to be connected with development, the anterior one being the future water vascular system, or generative organs, and the posterior one for the anus or cloaca. Manson has also found in filarial embryos whose movements have almost ceased that the head is constantly being uncovered from a very delicate prepuce, and can sometimes demonstrate that a short fang is shot out and retracted from the center of the head.

The Life History of the Filaria Nocturna.—The mosquito is the intermediate host, and man the definite host. Female mosquitoes of the genus *Culex* (*C. fatigans*), and, according to James, *Anopheles* (*A. niggorimus*), draw the filarial embryos from the infested individual. The parasites find their way to the stomach, where they escape from their sheaths, which they leave behind. They penetrate the stomach and enter the thoracic muscles of the insect, where they undergo a metamorphosis, which, according to Manson, requires from sixteen to twenty days to complete. The embryo is then transformed into a worm a sixteenth of an inch long, with the activity of the young parasite. A mouth and alimentary canal, and a trilobed tail, may be distinguished. Less often these larval forms may be demonstrated in the abdomen as well as in the thorax. When this metamorphosis has taken place the majority pass forward by the prothorax and neck of the mos-

quito, and, as Low has pointed out, enter the proboscis. This observation has also been confirmed by Manson, Annette, Dutton, and James. Manson states that in all the sections of this region which he has examined he has found two worms together in each instance. The parasite remains in this position until the mosquito feeds upon some warm-blooded vertebrate, at which time the parasite enters the definitive host. Bancroft found that filarial infested mosquitoes, fed upon bananas or other vegetable substances, do not part with the filariæ situated in their probosces.

After entering the human body the filaria finds its way into the lymphatic system, where it remains and develops into the mature parent worm.

Pathological Changes Produced by the Presence of the Filaria Nocturna.—The presence of filaria in the human body does not always give rise to manifestations. In the majority of individuals afflicted, ill effects are produced by the obstruction of the lymphatics, and the greater proportion of such manifestations are associated with the generative and urinary systems; and furthermore, the parent worm is most often here located.

It is not known that the parent filaria lives elsewhere than in the lymphatic vessels in the human body, nor is there evidence that they migrate from one part of the body to another. It is not known how long the parent worms may remain alive, and persons living in filarial districts are probably infected many times.

No pathological changes are produced by the embryos, so far as is known. The parent worms, on the other hand, produce obstruction directly or indirectly in the lymphatic circulation. While it is rare that the worms produce occlusion of a lymph-channel, their presence results in secondary changes, thickening the lymphatic walls and narrowing their lumina. Moreover, the location of the parent worm is not infrequently the seat of infection, producing abscess and lymphangitis, which further changes the structure of the lymphatic channels. Manson states that the ova are capable

of obstructing the smaller lymphatics and statis may be thus produced.

By thrombosing lymphatic channels there is a rise of lymph pressure in the occluded vessels resulting in varicosities and lymphatic œdema. As an effect a compensatory circulation is established.

Local Manifestations.—Great variation of the disease filariasis is displayed, dependent upon an engorgement of the lymphatics distal to the point of occlusion.

Flynn records fifty cases of filariasis, the clinical evidence occurring as follows: *Chyluria*, 9, 8 being males (one showed a palpable varicose condition of the prostate); *elephantiasis*, 7, 6 being females; *lymphscrotum*, 5; *chylous hydrocele*, 12; *intermittent orchitis*, 4; *varicose groin glands*, 13, all bilateral, and all in males.

The following changes are well recognized occurring singly or existing together: (1) Dilated lymph-vessels,—*lymphatic varix*, *lymphangiectasis*; (2) dilated lymph-glands,—*varicose glands*; (3) cutaneous lymphatic obstruction occurring as œdema,—*lymphscrotum*, *lymphvulva*, and *elephantiasis Arabum*; (4) rupture of dilated varices, producing chyluria, chylous hydrocele, chylous ascites, or chylous diarrhœa, according to the organ into which the rupture takes place; (5) manifestations produced by secondary pyogenic infection,—*lymphangitis*, *cellulitis* and *abscess*.

Dilated Lymph-Vessels. Lymphatic varix—lymphangiectasis.—By occlusion of the lymphatic channels there is a rise of lymph-pressure; the lymphatics distal to the obstruction become dilated, and a compensatory circulation is soon established, resulting in the formation of a lymphatic varix, varying in degree according to the amount of obstruction. The site of the obstruction, of course, varies the location of the varix. When the obstruction is in the thoracic duct, the chyle can only reach the circulation by a retrograde flow through the lymphatics of the groin, scrotum, pelvis, and abdomen. Dilatation therefore takes place in all the lymphatic vessels below the point of obstruction in the thoracic duct. Manson depicts a

case of Mackenzie's in which the abdominal and pelvic lymphatics formed a varix about a foot in diameter, concealing the kidneys, bladder and spermatic cords.

Opie reports the autopsy upon a case of *filaria sanguinis hominis* in which a plexus of enormously dilated lymphatic vessels was situated in the abdomen and pelvis, in front of the vertebral column. The plexus was continued along the whole course of the thoracic duct. From the plexus lymph varices extended along both spermatic veins as far as the epididymis, and a similar mass of dilated lymphatics was continuous along the course of the femoral artery and vein, and formed a mass in the groin. This mass was mistaken for a hernia at the patient's entrance to the Johns Hopkins Hospital, and was cut down upon, but not removed. The diagnosis of the true condition was not made until after death. Brodel's drawing of this case is the best illustration in literature.

Dilated Lymph-Glands (varicose glands).—It is unusual to observe varicose glands elsewhere than in the groins and femoral regions. Dilated lymphatic vessels can usually be demonstrated running to and from the nodes. The increase in size of the nodes is slow and usually without symptoms and they often attain a considerable size before they attract the patient's attention.

Upon inspection they resemble herniæ and unless they have been the seat of inflammation the skin is freely movable, the mass is soft, doughy, not tender, with an ill-defined outline. They decrease in size while the patient is in a recumbent position, and slowly enlarge when he is erect. The absence of impulse upon cough, tympany on percussion, and the demonstration of a normal sized external ring, may be the only features distinguishing it from inguinal hernia; and when situated in the femoral region the diagnosis is less easy.

The adult worms may have their seat somewhere in the thoracic duct, and the varicosities may be but a part of lymph varices existing in the abdomen and pelvis, as in Opie's case. On the other hand, the parasites may be situated in the groin-glands themselves. If a chylous fluid is obtained when the

lymph-glands are tapped, the obstruction is probably in the thoracic duct, but if the fluid is not milky, but clear, the parasite is probably contained within the mass.

Cutaneous Lymphatic Obstruction Occurring as Œdema.—*Lymphscrotum* results from obstruction in the lymphatics of the skin and is usually accompanied by dilated lymph-glands. Small varices may appear on the scrotal integument. These sometimes rupture with the escape of lymph. Inflammation is prone to occur and ulcerations, cellulitis, or abscess formations may develop in the deeper layers of the skin, while eczema is often encountered upon the surface.

Lymphvulva does not differ in any way from lymph-scrotum.

Elephantiasis Arabum.—There has been some dispute as to whether this condition is a manifestation of filariasis. Manson, however, has recently presented evidence in support of this theory. This affection does not, however, concern us.

Rupture of Dilated Varices, producing *chyluria*, *chylous hydrocele*, *chylous ascites*, or *chylous diarrhœa*.—In the condition cited the parasites are probably located in the thoracic duct, or one of its affluents, or in the tissues about the abdominal aorta. Engorgement and a retrograde current in the dilated vessels results. The pressure within the vessels may be sufficient to cause them to burst. The viscus into which the rupture takes place becomes the site for the collection of the chylous fluid. If this occurs anywhere along the urinary tract a mixture of urine and chyle results. If the rupture takes place into the tunica vaginalis, it results in chylous hydrocele, or chylocele; the abdominal cavity, chylous ascites; and into the bowel, chylous diarrhœa.

Chyluria.—Although the presence of chylous urine comes on suddenly it is the commonest external manifestation of filariasis. The rupture of the dilated lymph-channel may take place anywhere along the urinary tract, most commonly in the bladder and kidney. The urine contains, besides its normal constituents, chyle and lymph. The color of the urine varies with the process of digestion. It is usually milk-white soon

after digestion has commenced, on account of the excess of fats. Because of the presence of the lymphatic contents when the process of digestion is not active, the urine is turbid when voided, and soon separated into three or more distinct layers.

Hæmorrhage may be associated with chyluria, when the condition is spoken of as *hæmatochyluria*. It is believed by some that the sanguinous character of the urine in *hæmatochyluria*, is due to the rupture of the blood-vessels at a point near the place of rupture of the lymphatic vessels. Manson, however, attributes the presence of blood in the urine, in such cases, to the formation of blood-corpuscles in the lymph contained within the varicose vessels.

The urine may suddenly become normal in color, probably from a closure of the fistula. There is a tendency for chyluria to recur, and Lancereaux records a case where it was persistent for fifty years.

Chyluria is found to occur after childbirth, or violent effort in those suffering from filariasis.

The site of the filaria Bancrofti in this condition has never been absolutely demonstrated. Ponfick and Havellburg each record a post-mortem, and Mackenzie has had two cases which came to autopsy, and in no instance were the parent worms found. Pain in the back is usually present, from the greatly distended lymph-varix within the abdominal cavity.

Retention of urine sometimes results by chylous coagulation in the bladder and is not infrequently the first indication of trouble in the urinary system.

Flynn has demonstrated a positive Widal reaction in one case. The test has not been applied to any other cases, so far as I am aware.

Chylous hydrocele is the result of chyle being poured out in the tunica vaginalis. In the case reported by Lothrop and Pratt the dilated lymphatics of the spermatic cord were excised. This prevented the normal return of lymph from the testes and an accumulation of chylous fluid resulted in the tunica vaginalis.

A chylous hydrocele presents the ordinary physical signs

of a serous hydrocele except that the translucency is diminished. The parent worms are usually situated in the region of the testicles.

Manson, recording sixty-two cases of filariasis, found six cases of chylous hydrocele. Flynn records twelve cases in a series of fifty, and has demonstrated quantities of cholesterol crystals in the fluid drawn from the tunica vaginalis. Embryos have been demonstrated in chylocele fluid by many.

Chylous ascites is dependent upon the escape of chyle from the abdominal lymphatics into the peritoneal cavity.

Chylous diarrhœa is the result of the emptying of the dilated lymphatic vessel into the intestinal canal.

(5) *Manifestations Produced by Secondary Pyogenic Infection. Abscess, lymphangitis and cellulitis.*—Whether or not on account of injury to the lymphatics by a blow or otherwise, the parent filaria sometimes dies, and acts as an irritant, producing inflammation, often resulting in abscess, in the contents of which fragments of the dead filaria have been found.

If the inflammation is within the abdomen the general abdominal symptoms dependent upon inflammation are evident.

Lymphangitis and *cellulitis* occur commonly in all forms of filarial disease, particularly in varicose glands, lymphoscrotum, and elephantiasis. The lymphatic-trunks become cord-like, reddened, hot, and painful. The adjacent tissue and skin become inflamed and tense, and constitutional symptoms, ushered in by a prolonged rigor, with subsequent fever, continue for several days. Delirium and death may result. Usually, however, the attack is relieved by a discharge of lymph upon the surface of the skin, and a profuse general diaphoresis. This condition is spoken of as "elephantoid fever."

The Blood.—Filarial disease seems to exert little influence upon the red corpuscles or hæmoglobin. The white cells are however increased in number and there is a relatively high percentage of eosinophiles.

Gullard records a case in which the leucocytosis varied

from 4,600 to 13,500, and the eosinophiles between 3 and 12 per cent. In this case there was a constantly high proportion of lymphocytes, as well as eosinophiles, and the polynuclear forms never reached the normal minimum of 70 per cent. The most interesting point about Gullard's case is that the percentage of eosinophiles rose from a normal figure in the morning, when no filarial embryos were present, to a high percentage just before midnight, when a large number of embryos were in circulation.

Calvert found a leucocytosis and eosinophilia in two Filipino prisoners. He showed also that the percentage of lymphocytes was fairly high, and believes that filariasis, like trichinosis and akylostomiasis, has a positive chemiotaxis for eosinophiles, and that whenever the parasite is in the body there is an eosinophilia.

In one of Calvert's cases the leucocytosis reached 26,666, and in the other 14,000. The eosinophilia in the first case varied from 8. to 22., and in the second from 3. to 20.5.

He found the leucocytosis and eosinophilia to be most marked during the daytime, that is, when the embryos were not in the peripheral circulation.

Wherry and McDill found an eosinophilia varying from 6.0 to 10.0 in the morning, and 12.0 at midnight. Unlike Calvert's observations, they found the eosinophiles to be most numerous when the embryos occupied the peripheral circulation in the greatest numbers.

Wurtz and Clerc record an eosinophilia of 38.0, and in Lothrop's and Pratt's case the eosinophiles varied from 3.5 to 4.6.

Remlinger and Menchen Hodara-Bey record two cases of chyluria occurring in Egyptians. In these cases the eosinophilia was very high; in the first case 70.0, and in the second 75.0. They noted certain morphological changes in the eosinophiles. Each eosinophile presented very marked granulation in the protoplasm. Some leucocytes were observed, in which the granular material was outside of the cell, as though the cell-capsule had ruptured. They feel that the phagocytic

property of the leucocytes is diminished by this granular invasion and disintegration of the cells; and on this account suppurative processes are so common in filarial patients.

In the writer's case the blood observations show an increased number of leucocytes during the time at which the filarial embryos are in the peripheral circulation, and also a relatively high number of eosinophiles at this time. These observations are in accord with those of Gullard and those of Wherry and McDill. The lymphocytes remained constantly high, and were increased with the eosinophiles. There was little change in the mononuclear leucocytes from normal, but the polynuclears were decreased at all times. The eosinophilia, although slightly increased during the day, rose to a maximum at the time when the embryos were most numerous, reaching 20.5.

Following operation the red cells and hæmoglobin remained unchanged. The white cells showed no increase. The differential count showed that the lymphocytes had dropped almost to normal; that the mononuclear cells were normal, and that the polynuclears had risen and the eosinophiles fallen almost to normal percentages.

Prophylaxis.—There seems to be no doubt that filariasis is transmitted through the mosquito; therefore, any prophylactic measures against infection must depend upon protection from mosquitoes.

By special conditions for breeding the *Anopheles* may be annihilated from a locality. The *Culices* breed more readily, and select any collection of water for this purpose.

The protection of stored water from the insects and the frequent emptying of vessels containing water, so as not to allow sufficient time for larvæ to mature, and employing only that water which is freshly filtered, are the only means for the prevention of infection from this source. Mosquito-nets should be worn as a safeguard when in filarial districts. Individuals infected with filariæ are a constant source of danger to the community.

Treatment.—So far as is known, the embryos are not

harmful, and the treatment is therefore directed toward killing or removing the parent worm.

Medical Treatment.—Numerous drugs have been employed in attempting to cure filarial disease. Flint recommends methylene blue, 0.12 every four hours, and believes that he cured a case of chyluria by this means. Zellweger claims to have produced good results in five cases of lymph scrotum and chyluria with this drug, while Henry found methylene blue absolutely inefficacious. Thymol, benzoic acid, benzoate of soda, and boric acid have also been supposed to have a beneficial effect. Scheube claims to have killed the parasite by administering picric-nitrate of potash.

The most commonly employed drug is quinine, and although weak solutions will kill the embryo outside of the body, it seems to have no effect whatever upon them while in the circulation.

Recently Wherry and McDill exposed the back of a patient suffering with hæmatochyluria to the "X-rays." After the exposure the embryos were found to be in no way affected.

In hæmatochyluria some relief of symptoms has been gained by bladder irrigation with mercurial chloride, 1–10,000, boric acid, and other solutions of mild antiseptics. When the bleeding is considerable adrenalin chloride has been injected into the bladder, and given by mouth, with good results.

Medical treatment must be considered to be of use only to palliate the symptoms arising as manifestations of the disease itself.

Operative Treatment to be anything more than symptomatic and palliative must be directed toward removing the parent worm. The thoracic duct, pelvic and abdominal lymphatics are not readily accessible, and when the parent filariæ are here situated the only form of treatment that can be employed is absolute rest, with the hips elevated to reduce the hydrostatic pressure, and a light diet with restricted fats. Diuretics and cathartics are of value in reducing the tension within the lymphatics.

However, even if the adult worms are so situated and the lymph stasis has produced dilated lymph-glands, lymph scrotum, chylocele, or other external evidences of the disease which are annoying to the patient, operative treatment, as a palliative measure, has been followed by marked beneficial results. If, on the other hand, the local condition harbors the parent filaria, an operation removing the lymph-vessels, and the adult filariæ Bancrofti, will be curative.

Three distinct objections have been put forth against operation for the removal of lymphatic varices, and lymph adenocèles: First, that such operations are unscientific in principle, because only a portion of the varix is removed and the obstruction in the lymph circulation still remains. Second, that persistent lymphorrhagia and lymphatic fistulæ follow. Third, that such operations are liable to result in septic infection or erysipelas.

Operative experience has shown, however, that the varices are often local and can be entirely removed; that the patient may be cured of his symptoms even though the parent worms are not demonstrated in the excised mass; and that when the parent filariæ themselves are removed the patient is truly cured.

Maitland, who has had considerable operative experience with this disease, and who is familiar with the experiences of other surgeons in Madras and elsewhere, states that he has never known or heard of a lymphorrhagia or lymphatic fistula resulting from operation. Maitland states also that he has not seen or heard of a fatality by septic inflammation or erysipelas resulting from operation. He further states that a tight dressing placed over the wound causes the lymphatic channel to become sealed, and oozing does not take place in a greater degree than would from any operation wound.

Experience has proven that the suffering produced by the constantly recurring attacks of pain, erysipeloid inflammations and constitutional symptoms, has been relieved by removing varices which are accessible.

Following are brief outlines of the cases which have been operated upon:

PRIMROSE records a case of a man suffering from filariasis, upon whom he operated for lymphscrotum. In the excised tissue an adult filaria and several fragments were found. Twenty-four days after operation embryos were abundant in the blood; which showed that all the adult filariæ had not been removed. Forty-six days later the patient had an attack of lymphangitis in the neck. A circumscribed swelling developed, which was opened ten days later and sloughing tissue was removed. No adult worm was detected. Sixty-seven days after the second operation all embryos had disappeared from the blood.

MANSON expressed the opinion regarding this case that the first operation upon the lymphscrotum was not the one which cured the patient, but that the lymphangitis in the neck was probably the site of the remaining parent worm.

MR. H. J. STILES operated upon varicose groin-glands in a case in which Gullard studied the blood. No mention, however, as to the final outcome was made.

BROWN operated upon a case in which there was a straw-colored fluid in the tunica vaginalis. The testicle and the lower third of the vas deferens were removed. A small nodule was found situated in the testicle just under the epididymis. It had a compact fibrous periphery, and in the center was a yellowish-white, semi-fluid material. Smears were stained for tubercle bacilli, but none were found; instead, however, larvæ of the filaria sanguinis hominis were discovered.

MAITLAND reports three cases upon which he has operated with good results. First, a case of lymph-gland of the right groin. The entire mass was removed. The patient had remained well at a period four years after operation. Second, the case was of an individual with a large lymphatic varix in the right femoral region. The result nine years after operation was entirely satisfactory, and Maitland quotes portions of the patient's testimony, one sentence of which is as follows: "It is beyond description to write of the benefit of the operation," Nine years after the operation the patient was again attacked by the disease, the lymphatic obstruction being in the inter-abdominal vessels. The third case was one with a large lymphatic varix in the right groin, and a smaller one in the left groin. The mass in the right groin was removed, and suppuration occurred in the wound. One month after operation no filariæ could be demonstrated in the blood. The year of this operation was 1894. Maitland's report was in 1902, and in that time, he stated, the patient had remained well, and the varices in the left groin had caused no trouble.

FLYNN removed a varicose tumor of the left spermatic cord, leaving the testicle and vas deferens. The parent worms were not found, but the embryos disappeared from the blood, and it is believed that they must have escaped detection in the mass. Flynn has done partial excisions of the tunica vaginalis in five patients, and, as he expresses it "each patient considers himself cured."

LOTHROP removed a varicose spermatic cord, together with the

testicle and tunica vaginalis. Nine parent worms were found, and although filarial embryos were persistent in the blood the patient was relieved of his symptoms.

GODLEE, following the suggestion of Manson, cut down upon a lymph varix in the right groin, and anastomosed a dilated lymphatic vessel with a tributary of the internal saphenous vein. The result was that the lower part of the swelling disappeared. The upper part remained, however, and a month later he anastomosed one of the dilated lymphatic vessels of the cord with one of the spermatic veins. The swelling disappeared and has remained so. Manson and Godlee believe that the obstruction to the thoracic duct was opposite the lymphatics accompanying the spermatic vessels, and that although the obstruction still remains there is no regurgitation of chyle.

GODLEE operated upon another case with large swellings in both groins. the swelling in the right groin was exposed, and one of the lymphatics anastomosed with a vein. At a second operation the swelling in the left groin was exposed, partially removed, and a lymphatic was anastomosed with a tributary of the internal saphenous vein. A portion of the tumor in the right thigh was removed at the same time. There was considerable oozing of chyle and lymph subsequently, but the wound healed rapidly. The improvement was not so marked as in his previous case.

The cases of filariasis treated surgically are comparatively few. The relatively large number treated medically, and the little benefit so obtained, leads one to hope that more cases may receive surgical treatment. Even though the parent worms are not found, as in the writer's case, they may be retained within the diseased mass and escape detection, the embryos disappearing from the blood, and the individual remaining free from his symptoms.

On the other hand, when the parent filariæ are known to be left alleviation of the symptoms has followed by overcoming the stasis and regurgitation of chyle.

It is not without interest to note that there are five cases which committed suicide while under observation, and that another attempted suicide, but failed.

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THE RADICAL CURE OF FEMORAL HERNIA.*

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BETWEEN the years 1891 and 1906 I performed 117 operations for femoral hernia in 105 patients. In thirty-four of these operations the patients were children between the ages of two and fourteen years. Nine were males and eighteen females. In 3 operations the patients were under five years of age; in 15 operations the patients were from five to ten years of age; in 14 operations the patients were from ten to fourteen years of age.

Eighty-three operations were done upon adults, or patients between fourteen and seventy years of age. Of these patients twelve were males, sixty-five females.

It will be seen that in children the relative frequency of femoral hernia in males to females is one to two, while in adults it is about one to six.

The relative frequency of femoral hernia to inguinal hernia, as given by Macready (Statistics of the London Truss Ass'n) is one to 16.

At the Hospital for Ruptured and Crippled it is one to 17.

The fifteen thousand and twenty-eight cases of inguinal and femoral hernia operated upon for radical cure at various clinics and by various surgeons, collected by Pott,¹ show 933 operations for femoral and 14,092 operations for inguinal hernia, or a proportion of one femoral to fifteen inguinal.

My own operative statistic for the radical cure of hernia shows almost exactly the same percentage, namely, 117 fem-

* Read before the American Surgical Association, May 31, 1906.

orals in a total of 1,678 cases, or one operation for femoral to fourteen for inguinal hernia.

Previous statistics have almost uniformly given a slightly higher mortality in operations for femoral than for inguinal hernia, and also a smaller percentage of permanent cures. Unfortunately, there have been very few reports of any large series of operations for femoral hernia, and still fewer reports of cases traced for any length of time.

The careful analysis of Pott² of 933 cases of femoral hernia operated upon prior to 1903, shows that the results of operation for radical cure in femoral hernia have been distinctly inferior to those in inguinal, the percentage of permanent cures in inguinal hernia being 82 per cent. and in femoral 70.5 per cent.

He further shows that the results were much better when the femoral canal was closed than when the sac was simply excised and the wound closed without suture of the canal; the results being 63.3 per cent. of cures without suture, and 76.4 per cent. with suture.

A very large number of methods have been proposed and many of these are still in vogue; however, more by reason of the fact that they were devised by some distinguished surgeon, than by the fact that practical experience has demonstrated their value.

The hope of supplying some of the data necessary for determining the relative merits of different operations for femoral hernia, is excuse for the present paper.

The earlier operations consisted in simple excision of the sac without any attempt to close the canal. In such operations there was usually a recurrence within a year in 30 to 40 per cent. of the cases.

In 1890 Dr. Wm. T. Bull³ reported thirteen cases of femoral hernia operated upon by this method, eight of which were traced beyond a year, with three relapses. In 1889 and 1890 Cushing and Marcy published a form of purse string suture of the femoral ring and called it a "quilted" suture.

In later methods of operation, in addition to ligating the sac, an attempt was made to close the femoral canal. These methods may be divided into two main groups, *i.e.*:

1. Those in which an effort was made to close the canal by means of a suture applied in a great variety of ways;
2. Those in which it was attempted to close the canal by means of muscle, osteoplastic or heteroplastic flaps.

The suture methods may also be divided in two groups: (a) suture of external ring; (b) suture of internal ring.

Some of the methods of suturing the canal are exceedingly complicated, *e.g.*, the Lotheissen and the Gordon operations, 1898, and more recently those devised by Roux and Nicoll. The reasons advanced by the authors in favor of adopting these more difficult and complicated procedures for the cure of femoral hernia are all based on the supposition that femoral hernia is not readily curable by simpler methods. With this opinion I strongly desire to take issue.

The first paper of note going far to prove that almost perfect results can be obtained with simpler methods, was that of Bassini,⁴ who, in describing his own method for the radical cure of femoral hernia, reported fifty-four cases operated upon by the same, of which forty-one had been traced from one to nine years, without a single relapse.

The technique of Bassini's operation was exceedingly simple and easy of performance, consisting in high ligation of the sac and uniting the roof of the canal with the pectineal fascia and muscle by means of seven interrupted sutures.

A recent paper by De Garmo, reporting 110 operations for femoral hernia by a method similar to Bassini's, with but one relapse, furnishes additional proof of the strongest kind of the value of the simpler methods.

In my own cases, two methods only have been employed:

1. *Bassini's Method*, which was used in fifteen cases, with one relapse, the only variation being the substitution of kangaroo tendon for silk used by Bassini. The case in which a relapse occurred was the only one in which there was suppu-

ration, and to this fact the relapse may be attributed. The relapse consisted, however, only in a slight bulging of the canal, which disappeared after the use of a truss for a short time, and the patient is now well, ten years after operation. It can, therefore, hardly be classed as a true recurrence.

2. *The Purse String Suture Method*, which has been employed in 103 cases. It is based upon an operation devised by Cushing of Boston, in 1888, but differing from it somewhat in technique. The operation may be briefly described as follows:

An oblique incision is made one-quarter to one-half inch below Poupart's ligament and parallel with it, almost identical with the incision made for inguinal hernia, only slightly lower and a little shorter. The sac with the mass of extra-peritoneal fat that almost always surrounds it is then freed well up into the femoral opening. The masses of fat are carefully removed, the sac itself, by gentle traction, is brought down well beyond its neck to a point where it widens into the general peritoneal cavity. It is always opened before ligature, so make sure that it is empty. If omentum is present, this is tied off and removed. The ligature having been placed well beyond the neck by transfixion, it is carefully tied and the sac removed. When the stump of the sac has been pushed through the opening into the abdominal cavity, there is no longer any funicular process present in the femoral region. With a curved Hagedorn needle,⁵ threaded with kangaroo tendon of medium size, the suture is placed as follows: The needle is first passed through the inner portion of Poupart's ligament or the roof of the canal, then downward, taking firm hold of the pectineal fascia and muscle, then outwards through the fascia lata overlying the femoral vein, and finally upwards, emerging through the roof of the canal about one-quarter inch distant from the point of entrance (Fig. 1.) On tying this suture, the floor of the canal is brought into apposition with the roof, and the femoral opening is completely obliterated. The skin and superficial fascia are closed by means of an inter-

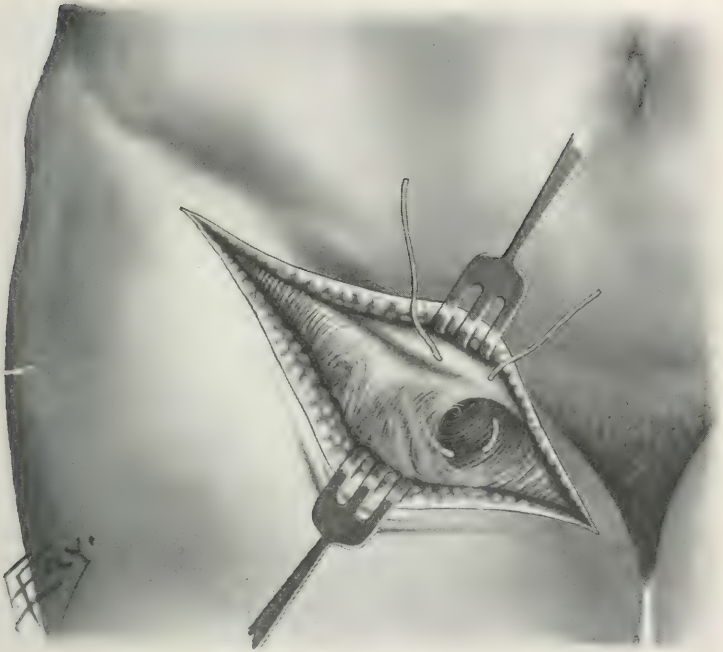


FIG. 1.—Obliteration of the femoral opening by purse-string suture.

rupted catgut suture and a sterile dressing is applied, without drainage. The first change of dressing is made at the end of one week. The patient is kept in bed for two weeks and allowed to go home at the end of two and a half weeks. A firm spica bandage is worn one week after leaving the hospital, at the end of which time no further support is needed.

The purse-string suture thus applied accomplishes exactly the same thing as Bassini's operation for femoral hernia, and it has the advantage that it is much more easily and quickly performed.

In the 100 cases operated upon by this method, most of which have been very carefully traced, there has not been a single relapse.

The final results of the present series of cases as far as traced, are as follows: Well over ten years, 5; well from five to ten years, 17; well from two to five years, 35; well from one to two years, 12; or 57 well upwards of two years; 69 upwards of one year.

As regards the ages of the cases operated upon, my statistics show the following: Under five years, 3; five to ten, 15; ten to twenty, 19; twenty to thirty, 32; thirty to forty, 29; forty to fifty, 11; fifty to sixty, 5; seventy years of age, 1.

These cases have in no way been selected and the method has been employed in the largest hernias with equally good results. There have been no complications, with the exception of a slight phlebitis in one case, which soon disappeared.

Mortality.—In the non-strangulated cases, there has been no mortality, and only one case of suppuration. In the strangulated cases, four in number, there was one death, in a woman, 55 years of age, in whom strangulation had existed for three days and the patient was in a desperate condition, necessitating resection of a large portion of the intestine. In another case, of strangulation, a man 70 years of age, operation was performed in a tenement house in a small town. The patient apparently made a good recovery, but died two to

three weeks later of some unknown cause. The physician in charge did not believe that death was in any way connected with the operation, although I do not think it fair to exclude the operation as a possible cause.

In the most recent edition of von Bergmann's *Surgery* it is stated that "simply closing the external femoral ring would accomplish little more than closing the external inguinal ring. Modern methods attempt to close the entire canal, including the internal ring."

Bacon of New Haven attempts to apply the same line of reasoning to the femoral as to the inguinal canal. He argues that the lesson taught by Bassini in inguinal hernia, that the proper place to start the obliteration of the canal is the internal ring, should apply with the same force to the femoral canal. He states that "the plans for the closure of the femoral canal have, until most recently, been subject to the same insidious defect which invalidated, more or less completely, the older of the so-called modern operations for hernia of the inguinal form, in that however firmly the crural end of the femoral canal has been closed, its abdominal end has not been satisfactorily obliterated, and thus the opportunity has remained for a knuckle of gut or a bit of omentum to insinuate itself along the tract of the old hernia, and so, in a certain proportion of cases, provoke its recurrence."

The earlier purse-string methods for closing the femoral canal, first brought out by Cushing and Marcy, 1888-89, while admitting that they are a distinct advance over the previous operations of plugging or invaginating tissues into the femoral opening, Bacon considers inferior to the method of Bassini. However, in the latter, he says, there are two weak points:

1. That the abdominal orifice of the femoral canal is not closed;
2. That "the breach in the belly wall is attacked at the wrong end of the femoral canal; furthermore, that the crural arch itself is closed at a mechanical disadvantage."

Kammerer,⁶ in a more recent article on Femoral Hernia,

FIG. 2.



gives expression to a similar criticism, and states that Bassini's method practically only closes the external femoral ring. He further adds: "The same, I think, can be said of the various forms of the purse-string suture which, if anything, only creates greater tension." Kammerer believes that the method of Fabricius, in which an attempt is made to obliterate the opening at the internal ring by dividing the superior cornu and some of the fibres of Poupart's ligament sufficiently to relieve all tension and permit the parts to be sutured to Cooper's ligament, is a distinct improvement over Bassini's operation or the purse-string suture and the Lotheissen and Gordon methods he regards as still better.

The point I would make in discussing these various criticisms of the Bassini and purse-string methods, is that the value of an operation in surgery cannot be settled thus easily, and least of all can it be estimated according to the degree to which it fulfills certain theoretical geometrical or mechanical conditions. There are a great many other factors that enter into the question. Let us take, for example, the McBurney operation for inguinal hernia. Theoretically, it seemed an ideal operation. Yet experience proved it to be of little value, because it failed to take into consideration the fact that scar tissue subjected to pressure or tension has the power of stretching or yielding indefinitely. Many of the more complicated methods for femoral hernia, while they may be theoretically and mechanically correct in principle, depend for their success upon some seemingly minor factor which is given too little consideration, yet which may completely annul their supposed superiority. This is well illustrated by those methods in which the canal is perfectly closed and obliterated by means of metal nails or silver-wire sutures; yet, the very presence of these foreign bodies often brings about secondary sinuses with supuration, which, in turn, may be the chief cause in producing a relapse.

As to the Gordon method, so strongly advocated by Bacon and Kammerer as well as the other methods of closing the

femoral ring from the inner side, necessitating opening the inguinal canal, the possibility of an inguinal hernia resulting from an attempt to cure the femoral, should not be lost sight of. Not a single surgeon has reported more than an insignificant number of cases operated upon by any of these methods and in none of the reports were the cases traced for any length of time.

While we may be willing to grant the truth of the statement of Bacon that "it is far better to follow a mechanically correct paradigm than to practice an operation whose mechanical deficiencies must be supplemented by peculiar skill or extraordinary experience on the part of the operator," yet, it must be conceded that, if the success of the simpler operation of Bassini and the purse-string methods depended upon peculiar skill or extraordinary experience on the part of the operators, how much greater skill and experience would be required to successfully perform an operation like the Gordon method, for the understanding of which Bacon himself has thought it necessary to devote seven pages of description?

The value of an operation for femoral hernia, as the value of all operations in surgery, should, I believe, be estimated not by trying to ascertain how nearly it fulfills certain theoretical considerations, however important they may appear to the individual surgeon, but by finding out to what extent they meet two very practical tests: 1. Simplicity, including safety; 2. Efficiency; that is, permanence of cure.

Of two methods of operation giving equally good results, that method which is the simpler, and more easily performed, should have the preference.

The purse-string method that I have described, I have used in 100 operations without a single relapse. These operations, extending over a period of fifteen years, and including all varieties of femoral hernia, without distinction as to size of the hernia or age of the patient, would seem to show that the method had satisfactorily stood the practical tests that I have laid down. Moreover, it is the simplest in technique and

most easily learned of all the various methods with which I am familiar.

In discussing my earlier results, Kammerer⁷ states that he does not believe sufficient time had elapsed to warrant definite conclusions as to ultimate results, and quotes the statistics of Heidenthaler to show that the femoral hernia in which the external femoral opening has been sutured, recur very late, on an average after two years.

Heidenthaler's article was published in 1890, and Kammerer himself states that Bassini's article, published in 1894, represents the first systematic attempt to close the femoral canal in addition to ligating the sac. It is true that there were a few earlier cases reported by Marcy, Bull and Cushing, in 1889-90, but these cases were manifestly too few and widely scattered, as well as imperfectly traced, to enable Heidenthaler as early as 1890 to draw any conclusions as to the interval of time between operation and relapse in cases operated upon with closure of the external ring.

At the Hospital for Ruptured and Crippled we have kept very careful records of all cases of relapsed hernia operated upon by various methods and in various clinics during the past sixteen years. An analysis of these cases, already published in previous papers, shows that in 504 relapsed cases, including all varieties of hernia, the relapse occurred during the first six months after operation in 83 per cent. and during the first year in 90 per cent. of the cases.

This experience is confirmed by the findings of Pott, who in a series of 145 collected cases found that recurrence took place within the first six months, in 71.66 per cent., and during the first year in 91 per cent.

In these statistics no attempt was made to separate the femoral from the inguinal relapses, but in view of the point raised by Dr. Kammerer, I have recently made a study of the entire list of femoral cases, with the following result:

Within the past sixteen years, twenty-eight cases of relapse following operation for femoral hernia have been observed at

the Hospital for Ruptured and Crippled. Of this number the time of relapse is not definitely stated in three; in eleven it took place within the first six months after operation, in six, between six months and a year; or seventeen relapsed within the first year, being equal to sixty-eight per cent. Five cases (twenty per cent.) relapsed after one year and only three (or twelve per cent.) later than two years after operation.

The method of operation in these cases was not in all instances definitely stated, but in the majority some attempt was made to close the external ring.

These results fail to confirm the opinion expressed by Heidenthaler, that most of the relapses of femoral hernia occur after two years, but show that—as in inguinal hernia—the great majority of relapses are observed within the first year after operation, and only twelve per cent. after two years.

¹ Deutsche Zeitschr. f. Chir., 1903.

² Loc. cit.

³ Med. Rec., vol. 57.

⁴ Arch. f. Klin. Chir., 1894, vol. 47.

⁵ In my earlier cases I used a special needle, somewhat resembling an aneurism needle, for the introduction of the purse-string suture, but soon gave it up for the Hagedorn needle which, with a little care, may be used with perfect safety and much greater facility. I now use a needle holder.

⁶ ANNALS OF SURGERY, 1904, vol. 39.

⁷ Loc. cit.

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CYSTS OF THE URACHUS.

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THE literature on the subject of cysts of the urachus is not voluminous and is much scattered. Statistical papers are very rare. Wutz,¹ writing in 1883, denies that any large, clinically-important cyst of the urachus had been reported up to that time. He analyzes all the alleged cases, whether found at autopsy or seen clinically, and rejects them all; because they represent either notable diagnostic errors or data too scanty to justify a diagnosis. He gives no formal conclusions, but simply analyzes each reported case. He evidently expects that a typical case should show in its cyst-wall the presence of each anatomical layer of the urachus from which the cyst is believed to form by partial dilatation. Thus, in an ideal case we should find, first, stratified epithelium, and second, smooth muscle fibres, as well as the non-dilated portion of the urachus. The cyst should also lie outside and in front of the peritoneal cavity.

The minute cysts claimed in his day as urachal are summed up as follows:

1. All have their seat in the lower fourth or third of the distance or space between the navel and vertex of the bladder, and proceed from the normal, persistent portion of the urachal canal.

2. The majority have stratified pavement epithelium; a few, only a single layer.

3. All cases have a more or less pronounced envelope of smooth muscle fibres.

4. Size from microscopic to bean.

The essentials are not demonstrable in the alleged large cysts of the urachus reported at autopsy or clinically.

Small cysts, microscopic to bean size, he claimed were relatively frequent, as he had seen seventy-four cases; but as these are of no clinical importance I shall not consider them in my statistics.

Doran,² like Wutz, whose critical acumen he praises, does not indulge in any concluding generalizations, but, using Wutz as a guide, is content to show that all reported cases of urachal cysts of large size are more or less defective.

His own case is apparently well documented, and he seeks to show that it could not have been any other pathological condition, such as might form in that locality (organized peritoneal effusion, encysted dropsy, abscess cavity, etc.). Yet despite positive evidence and results of exclusion, he does not seem to commit himself to an absolute diagnosis. He is evidently deterred by the fact that Wutz, with much better opportunities for exact work, was led to a non-committal point of view.

Cases other than his own are discussed pro and con with the outcome that they are not beyond criticism, although in many cases satisfactory for ordinary requirements.

Thus, the conclusions reached by both Wutz and Doran are seen to be destructive rather than constructive to the statistical side of my subject.

The reports by Hoffman³ in 1870, Wolff⁴ in 1873, and Atlee,⁵ 1873, furnished about the only information upon the subject until Tait's⁶ article appeared in 1883, followed in 1886 by his report of twelve cases as reported to the British Gynæcological Association.⁷

To Mr. Tait belongs the credit of being the first to make a diagnosis in these cases prior to operation. His teachings were of great value in explaining this bewildering pathological condition to the abdominal surgeon of twenty years ago.

Since that period a few writers have studied and reported upon the subject.

Dr. F. Byron Robinson⁸ has reported four additional cases operated upon by Tait and two personal cases seen elsewhere. He reports his observations in studying the urachus of the foetal calf, foetal pig, cow, dog, sow and sheep. The bulk of the paper is made up of his observations while with Mr. Tait, followed by his conclusions. The paper is of much value to the student of this pathological phenomenon.

Freer⁹ and Douglas¹⁰ also furnish comprehensive articles upon the subject, with report of cases.

My own cases, three in number, are rather typical of the more serious type of these cases by reason of their considerable size and their dipping down into, and being adherent to, the pelvic viscera; and their being in each case extra-peritoneal, with bladder attachment, makes the diagnosis conclusive.

CASE I.—Female, age 75. Family history negative. Patient had, aside from diseases of childhood, always enjoyed perfect health. Had three children, with normal pregnancies and labors. For fifteen years had suffered the inconvenience of a discharge of pus from the umbilicus. The discharge was constant, and at times, following an enlargement of the abdomen and pain, it became profuse, relieving the pain and causing the swelling to diminish to such an extent that care was required in its detection.

At various times she had consulted physicians in reference to the condition, but aside from prescribing various washes and ointments, no treatment or diagnosis was offered.

She was finally referred to me, and an examination revealed the following conditions: Patient well preserved and active for her age. The abdomen was very fat, and a tumor, cocoanut size, presented in the median line between the umbilicus and symphysis pubis. The mass could be raised with the abdominal wall, and was apparently attached thereto.

There was a copious discharge of foul-smelling pus from the umbilicus, and an eight-inch probe passed into the sinus failed to reach the lower wall of the sack. The temperature

was 101°; pulse 100. She volunteered the information that it was no worse than usual, but she was not feeling so well generally, and there had been, during the past month, very frequent micturition.

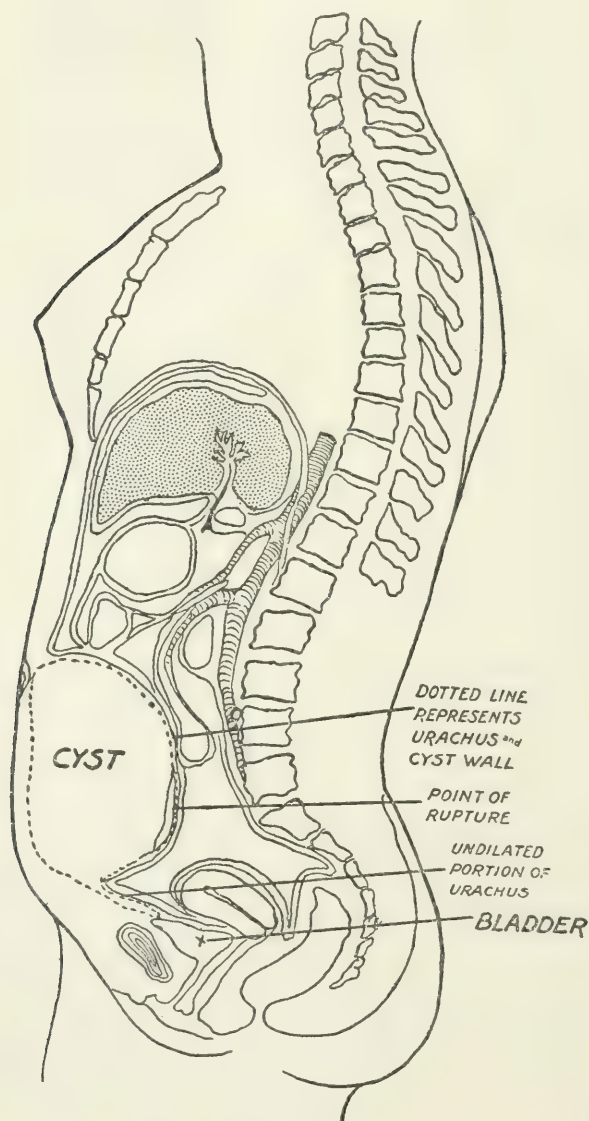


FIG. 1.—Cyst of Urachus.

Under ether anæsthesia I excised the umbilicus and unhealthy skin surrounding it, and, incising down through two inches of fat, came upon a bulging mass extending from the umbilicus as far down as I could feel toward the symphysis pubis. (Fig. I.) This I tapped, and evacuated about five ounces of horribly fetid pus, followed by a calculus weighing 70 grains. Exploration with the finger demonstrated the fact that the cyst had a thick and indurated wall and dipped well down to the pelvis.

Up to this point in the operation I had not opened the peritoneal cavity. I now washed out the sac and packed it with gauze and entered the peritoneal cavity above the location of the tumor. To my surprise I found the mass densely adherent to the intestines posteriorly, and, passing my hand down into the pelvis on the outside of the cyst, discovered it to be closely associated with the bladder. I now concluded that I was dealing with a urachal cyst, and as the posterior wall was almost entirely made up of intestines, I concluded to cut away such portion of the sac as seemed safe. I left the posterior wall intact, as well as that portion which dipped down into the pelvis. The wound was closed so far as I had peritoneum and the balance walled off with a coffer-dam drain of iodoform gauze. Her recovery was uneventful, but required three months to close the sinus.

CASE II.—Female, aged 11. Was admitted to the Mercy Hospital April 11, 1905, with the following history furnished by Dr. M. W. Pearson, who referred the case.

The child had complained for some days of headache and vomiting, gradually developing slight tenderness and some pain in the abdomen, but not severe at any time. There was at first no localized tenderness and very little distention. One week prior to admission a general flatness was noted, with fluctuation. The abdomen became more and more distended.

On admission her temperature was 101.2° , pulse 172, respiration 30. The child was pale and emaciated, with a dry tongue and anxious expression. She complained bitterly of abdominal pain, and the entire abdomen was tender, but especially so about the umbilicus. The abdomen was greatly distended and board-like. Flatness extended from the umbilicus to symphysis pubis and from a point two inches to the right of the median line, almost completely into the loin on the left side. Entirely

surrounding but especially above the umbilicus was a zone of redness one and three-eighths inches in diameter, which represented an area through which the abscess was ulcerating toward the surface. A positive diagnosis was not made prior to operation, but tubercular peritonitis and suppurative urachal cyst were both considered.

Under ether anæsthesia the abdomen was opened in the median line between the umbilicus and symphysis. Absence of the peritoneum made a diagnosis quickly possible and a peculiar state of affairs presented. The abdominal cavity was divided into two compartments by the sac wall, which displaced the intestines almost entirely to the right side of the cavity and walled them off. Almost the entire left side below the umbilicus was filled with the cyst, which had ruptured, as shown by Diagram No. 2. Except at the point of rupture the cyst contents were entirely extra-peritoneal, although occupying so large a part of the abdominal cavity. Several pints of free pus was confined to the left side and was not in contact with the intestines.

The position occupied by the mass is fairly well shown in diagram, Fig. II. The urachus was patulous down to within three-eighths of an inch of the bladder and was ligated at that point; so much of the sac as could be dissected out without tearing up the limiting wall was taken away, and the abscess cavity washed out and drained with a coffer-dam drain of iodoform gauze.

An area two by four and one-half inches was bare of peritoneum at the site of wound, but there has been no trouble from this source.

CASE III.—Male, aged 73. Referred by Dr. Stowell. Family history negative. Had always been well, except an attack of orchitis four months previous. For six months he suffered with pain and soreness in the abdomen, but noticed no tumor. Two weeks before my visit the abdominal wall opened spontaneously two inches below the umbilicus and discharged urine. There had never been any pus. If lying down quietly the urine did not escape, but so soon as he assumed an upright position there was a constant discharge.

The old gentleman appeared perfectly well aside from this urinary sinus, which was about the circumference of a pencil

and entered immediately into a large sac, the lower limit of which I could not reach with an eight-inch probe.

Under ether anæsthesia I entered the peritoneal cavity

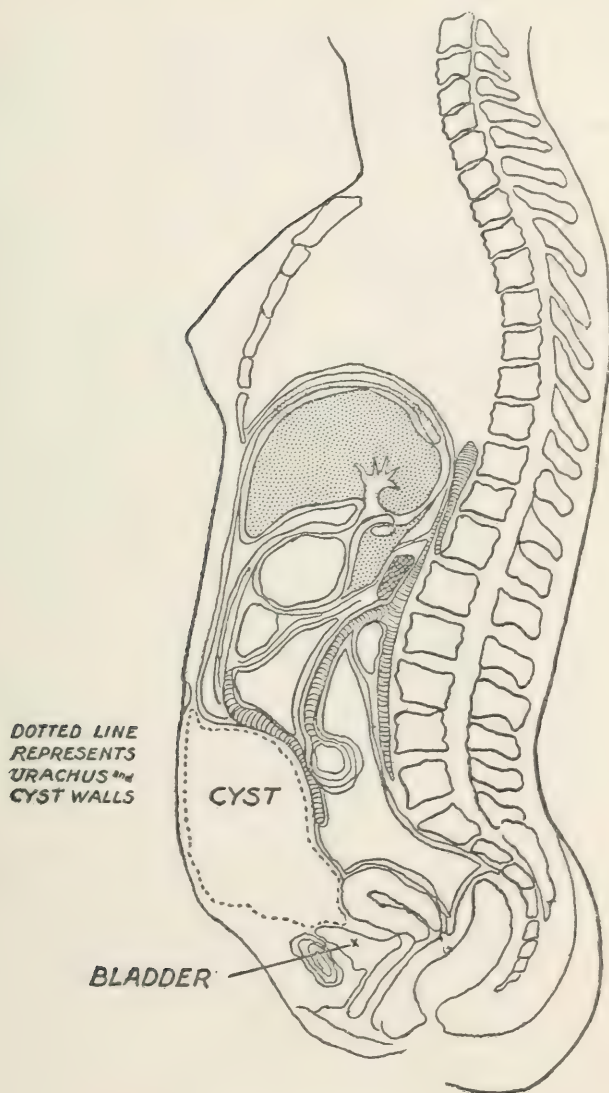


FIG. 2.—Cyst of Urachus.

above the sinus and found the sac anterior to the parietal peritoneum. The sac extended to within one inch of the umbilicus, above which the urachus was not patulous (Fig. III.), and down-

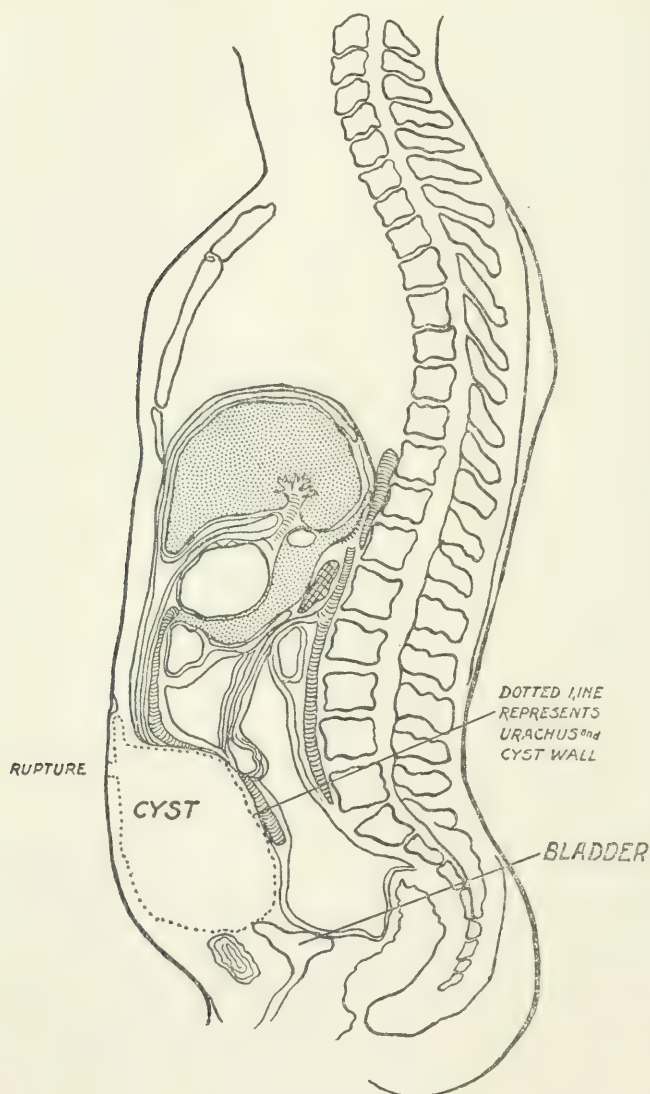


FIG. 3.—Cyst of Urachus.

ward into the pelvis. It was intimately connected with the bladder at the point of urachal contact and was densely adherent to the posterior bladder-wall, as well as to the intestines, the greater part of the posterior sac-wall being made up of abdominal viscera. After freeing the anterior wall of the cyst sufficiently, I made a plastic closure of the original point of rupture through the abdominal wall. A catheter was passed into the bladder through the urethra and allowed to remain for several days. The abdominal wound was closed without drainage. Patient made an uninterrupted recovery and was about the house on the fourteenth day.

Two months later I was told by Dr. Stowell that the abdominal wall had given way again a trifle lower down toward the symphysis, and urine is again discharging through a small sinus. I have advised its closure, but shall not attempt anything more radical than plastic closure, not entering the peritoneal cavity, since I think total extirpation impossible.

Since writing the above, I am informed by Dr. Stowell that the opening has closed spontaneously, and urine is voided entirely through the urethra.

TABLE OF CASES OF CYST OF THE URACHUS REPORTED IN MEDICAL LITERATURE.

Case No.	Operator and Reference.	Age	Sex	History and Symptoms.	Treatment.	Character of Cyst Contents.	Result.	Remarks.
1	Wolf, Inaug. Dissertation Marburg, 1873.	31	F.	Two years before had noted small tumor in left lower abdominal region. Fever present. Was in fourth month of pregnancy. Next few days rapid increase in size.	Incision and evacuation of fluid. Mass extirpated.	Five litres yellowish serous fluid.	Not stated.	
2	"	2½	M.	Moisture about navel from time of birth. Blood and pus discharged from time to time but never urine. Small aperture in lower part of ring. Upon pressure serum escapes. A sound introduced reveals a canal running in a downward direction along linea alba.	Opening dilated by a laminaria tent whereupon a teaspoonful of yellowish-green pus escaped.	Teaspoonful of yellowish-green pus.	Discharged without cure.	
3	Alee, Ovarian tumors, 1873, p. 50.	18	F.	When about to remove an ovarian tumor, the incision in linea alba, between umbilicus and pubis, opened a small cyst from which an ounce of yellowish fluid escaped. He finished the ovarian operation and closed the wound. Six days later dressings began to be saturated with a thin fluid which was devoid of smell. Urine passed normally. Nevertheless the oozing fluid was later found to be the same as that escaping by the urethra.	Patient ordered to void urine frequently whereupon the escape of fluid from the wound ceased and the wound closed completely.	Yellowish thin fluid devoid of smell.	Cured.	
4	Scholz - Bericht I. K. K. allgemein. Krankenhäuser, Wien, 1877.	16	F.	Vesical tenesmus, tumor and tenderness in abdominal region. Belly prominent, ovoid, largest just below navel, where a hard fluctuating mass was present. Navel gradually became thin and opened an albuminous-like fluid oozing forth.	Opening dilated and fluid evacuated. No further operation.	300 C. C. colorless transparent fluid. Tenacious. Eventually much thick yellow pus.	Healed in two months.	No diagnosis.
5	Roser, Arch. f. klin. Chirurgie, 1876, XX. p. 472.		F.	Three months pregnant when acute abdominal swelling appeared. Tapped and pregnancy went to term with normal delivery. Four years later, pregnant again. Fluid reappeared, patient aborted. Temporary communication between cystic mass and bladder.	First tapped and wash-basin full of fluid removed. Second operation, laparotomy, incision of cyst and evacuation of three litres of foul ammoniacal purulent fluid. After a long period during which catheter was passed every two hours, it healed.	Foul purulent ammoniacal fluid.	Cured.	

9	Hoffmann, Arch. f. Heilkunde XI, p. 373.	28	M.	Thick abdomen even in youth. Increased in size at 24, with dyspnea, fluctuation to right side, for which he was tapped. Patient well for two years when he again became worse.	Tapped and two years later a second tapping.	Reddish-yellow thin fluid. Seventy-five litres at second tapping.	Death.	After death fifty litres residual fluid in sac. Diagnosis at autopsy.
7	"	28	M.	One year before had fluctuation beneath costal arch to left. Pains in right lower abdominal cavity for ten years.	Tapped twice.	Six litres greenish-yellow clear and albuminous fluid. Second tapping 103 litres bloody fluid becoming purulent and urinous.	Death.	Diagnosis at autopsy.
8	McLean, Md. Record, Feb. 8th, 1879.	24	F.	In 1867 pains and bloating in abdomen with indications of growth in left iliac fossa. In 1876 the mass attained large dimensions. Abdomen uniformly enlarged.	Laparotomy after tapping abdomen. At lower angle of incision a cyst of the abdominal wall was wounded, two drachms of pale fluid escaping. Large mass was ovarian tumor, multilocular. This was removed and pedicle ligated. Bladder had been wounded and was repaired.	Pale fluid.	Death, 30 hrs. after operation.	Autopsy showed bladder to be intact and densely adherent to abdominal wall.
9	Heinecke, Billroth, and Pithas, Allgem. und Speciale Chirurgie, 1879, III, 2, 2, p. 64.	33	F.	Primipara. Two years before abdominal distention noted. Most marked below navel. Dull to percussion on left side as far back as lumbar region. Puncture with evacuation of albuminous fluid and numerous squamous epithelial cells in fatty degeneration.	Laparotomy, cyst exposed by the incision. This was incised and emptied and an attempt made to dissect it out. After much trouble the anterior wall was detached from the abdominal parietes and an attempt made to roll the mass out but this was impossible as intestines seemed to be part of the posterior wall.	Albuminous fluid and squamous epithelia in fatty degeneration.	Death "soon after."	At autopsy the author seemed to think his diagnosis of urachal cyst wrong and that the real condition was encysted peritoneal exudate.
10	Helmuth, Contributions to Gynecological Surgery, p. 16.	54	F.	Multipara. When 14 years old a mass the size of an apple formed at the navel and burst with projectile escape of water. After menopause at 44, the abdomen became enlarged and tender.	Tapping, and then laparotomy. A peculiar mass exposed which was adherent to abdominal wall. Incised with escape of fluid. This cyst was pushed aside and a large ovarian cyst extirpated. The smaller cyst communicated with the bladder. Its walls were repaired in a suprapubic lithotomy.	Quant of dark viscid fluid.	Death from peritonitis on fifth day.	No autopsy.
11	Helmuth Case reported by Freer, ANNALS OF SURGERY, 1886, V, p. 110.	2 or 3 mos.	M.	Said to pass urine through the navel. A hollow growth one and one-half inches long at navel communicating with a pervious urachus. Discharge continuous.	Operation of ligation proposed but refused.	Urine.		

TABLE OF CASES OF CYST OF THE URACHUS—Continued.

Case No.	Operator and Reference.	Age.	Sex.	History and Symptoms.	Treatment.	Character of Cyst Contents.	Result.	Remarks.
12	Freer, <i>Annals of Surgery</i> , V, 1887, p. 107.	Middle aged	F.	Inability to urinate at will, by reason of cyst of urachus which filled up to extent of several litres. By compressing the cyst, she could empty the bladder in part only. She became pregnant and it was necessary to tap her. After gestation, she did well for four years, when she again became pregnant. She was tapped again and aborted. The communication between cyst and bladder closed spontaneously and patient had no further annoyance.	Tapped twice.		Recovery.	
13	Freer, <i>Annals of Surgery</i> , V, p. 112.	10	M.	Urine contained blood and pus and treated successfully, but shortly afterward urine began to escape from navel. Just before this happened a growth which had appeared at the navel ruptured.	Fistula dilated with a laminaria tent and fistula closed by cauterization and use of subcutaneous ligatures. Ten days later re-opened, supplicated and was again closed. Plastic operation for umbilicus followed by peritonitis.		Death.	Autopsy old peritonitis. Trabecular bladder which also contained a septum between uretral openings. Cystic cavity communicated with bladder and contained two openings marking site of ruptures which had caused peritonitis.
14	Freer, <i>Annals of Surgery</i> , V, p. 110.	40	F.	Purulent discharge. Sound introduced at navel, located a cavity three inches broad at widest diameter. Several ounces of pus could be squeezed out. Communication between cyst and bladder.	Cyst treated antiseptically and healed without operation. Patient stated that this had been done several times before.	Pus.	Cured.	
15	Freer, <i>Annals of Surgery</i> , V, p. 111.	26	M.	Had a large abdomen since infancy. Marked increase in size recently. Fluctuation, in and around umbilicus. Dyspnoea increasing necessitated tapping. Remained in good health for two years when abdomen re-filled and patient became cachectic. Second tapping brought away six litres bloody fluid. In next nine months three more tapplings, 18½, 17 and 6 litres respectively.	Repeated tapplings.	Considerable reddish-yellow fluid at first tapping.	Death.	Autopsy. Patient weighed 102 lbs. but cyst contained 50 litres of fluid equal to 100 lbs weight. Cyst did not communicate with bladder. A smaller cyst lay between it and the bladder

91	B r a m a n n, Arch. f. klin. Chirurgie, 1887, XXVI, p. 1004.	36	F.	Eighteen years before, an abdominal tumor had appeared, with high fever, pain, vomiting, etc. Attending physician found tumor size of fist in umbilical region, a little to the right of and above the navel. This persisted with fluctuation in size, and a tendency to approach the symphysis. Two years later rupture at navel and escape of foul pus. Fistula persisted until present consultation. Oval tumor exactly in median line reaching from navel to symphysis and five cm. wide. Urine had always been voided normally.	Laparotomy. Incision to fistula with escape of pus. Extraction of four concretions size of pigeon's egg. Fistulous tract curetted and cavity of cyst tamponed and afterward drained with tube.	Foul pus.	Recovery after three months.	Concretions appeared to be gall stones. Author unable to account for their presence.
17	Flemming, Trans. Glasgow Pathol. and Clinical Society, 1888, III, p. 99.		M.	Admitted to hospital for swelling inguinal region which appeared after he had jumped from a cart. Thought he had sustained a rupture and put on a truss. No improvement. Swelling persisted and grew larger. Large fluctuating mass above Poupart's ligament on right side. Crural ring intact. Yellow fluid aspirated by needle. Later nine ounces dull yellow fluid removed by trocar and iodine injected. Fluid behaved like hydrocele fluid. Said to contain spermatozoa, also cholesterol.	Laparotomy. Cyst incised, scraped and drained.	Yellow fluid.	Recovery.	
18	Teichmann and Tait, Lancet, 1888, II, p. 675.	28	F.	Fever and vomiting were followed by appearance of hard painful tumor between umbilicus and pubes somewhat to the left side. No mention of suppuration at any time or of a diagnosis before operation. Cyst a large one dipping into pelvic cavity attached by short pedicle to abdominal wall.	Laparotomy. Enucleation. Cavity drained and margins stitched to abdominal wall. Peritoneal cavity was separately drained.		Recovery in three weeks complete.	
19	Schullenbach, Inaug. Dissertation, 1888.	66	M.	Fistula at umbilicus which discharged a turbid fluid constantly. Urine could be withdrawn through fistula by catheter.	Laparotomy. Incision of cysts with escape of a lure of pus and urine. Cyst extirpated.	Pus and urine.	Recovery.	

TABLE OF CASES OF CYST OF THE URACHUS—Continued.

Case No.	Operator and Reference.	Age.	Sex.	History and Symptoms.	Treatment.	Character of Cyst Contents.	Result.	Remarks.
20	Lawson Tait, British Gynecological Journal, 1886-7, II, p. 328.	56	F.	Abdominal pain and tenderness, vomiting, swelling of abdomen. These increased for four months when tapped for a supposed ascites. Ten pints of fluid drawn off. Not ascites but cystic. Diagnosis of parovarian cyst. Fluid re-collected at once.	Laparotomy. Cyst incised. Thirty pints evacuated. Much fibrin present. Cyst now extirpated. Uniform attachment to peritoneal wall in front and peritoneum behind. Cyst removed bodily. Inner aspect of broken-down epithelium infiltrated with pus. Muscular coat beneath epithelium.		Death in three days.	
21	"	39	F.	Great pelvic pain and abdominal swelling. Hard mass to be felt on left side, which in two months had become central. Amenorrhœa purulent urine. Supposition of ovarian cyst.	Laparotomy. Cyst tapped and seven pints putrid urine drawn off. Cyst everywhere adherent. Separated as far as possible behind. Wound closed and drained with tube. Urinary fistula remained about a month after operation. Patient aborted, dying suddenly.	Putrid urine.	Death in one month.	No autopsy.
22	"	39	F.	Condition dated back three years and when seen by Tait appeared too far gone for intervention.	Laparotomy. Cyst gangrenous and full of pus. Peritoneal cavity not opened. When stitches were removed the wound re-opened and discharged dark unhealthy pus.	Pus.	Death in seven-teen days.	No autopsy.
23	"	21	F.	Symptoms of parovarian cyst.	Laparotomy. Cyst found to be extra peritoneal. Contents clear. Cyst emptied, sponged out and drainage tube inserted. Suppuration began immediately and continued profusely until patient died of exhaustion.	Clear fluid.	Death in six weeks.	No autopsy.
24	"	33	F.	Profuse menstruation for which she was cured with benefit. Shortly afterward had chills followed by evidence of peritoneal effusion. Physical signs of encysted fluid, evidently purulent.	Laparotomy. Condition found exactly like that in last case save that contents of cyst were purulent. Drainage as above.	Pus.	Death.	No autopsy.
25	"	37	F.	Symptoms of pelvic tumor. From its relations expected a condition like all the preceding, <i>i.e.</i> , an extraperitoneal cyst.	Laparotomy. Cyst emptied and drained. Case did well for twelve days when all the urine began to appear through the tube. Sinus finally closed without operation.		Cured.	

26	Lawson Tait, British Gynecological Journal, 1886-7, II, p. 328.	17	F.	Large tumor of abdomen and pelvis.	Laparotomy. Cyst evacuated by incision, six quarts clear fluid coming away. Drainage tube inserted.	Clear fluid.	Cured.	
27	"	17	F.	Two months before consultation abdomen began to enlarge. Hectic appearance indicated suppuration. Diagnosis of purulent peritonitis.	Laparotomy. Condition found exactly like the preceding case. Circular drainage.	Clear fluid.	Cured.	
28	"	29	F.	Confined three weeks before. Began to increase in size enormously, immediately after.	Laparotomy. An intraperitoneal cyst found containing nine pints of fluid. Peritoneum not opened. Circular drainage, a tube being passed through the retrouterine cul-de-sac into the vagina.		Cured.	
29	"	41	F.	History of ovarian tumor which had been tapped and operated. Thought to have been a sarcoma with subsequent infection of peritoneum (Thornton).	Laparotomy by Tait. Old scar found in cyst wall. Case inoperable but not sarcomatous. No solid portion found. Drained.		Cured.	
30	"	17	F.	Referred to Tait as acute inflammatory disease of abdomen. Exact diagnosis impossible. Pulse and temperature high and much free fluid in abdomen.	Laparotomy. Piece of cyst excised for diagnosis. Circular drainage.		Cured.	Microscopical diagnosis Allantoic cyst.
31	"	23	F.	Ailing for nine months and in bed two weeks. Hectic and emaciated.	Cyst tapped and six pints of purulent serum evacuated. Incision extended and diagnosis then made of allantoic cyst.	Purulent serum.	Cured.	
32	Bantock.	30	F.	Abdominal tumor. No history.	Laparotomy. Incision of cyst and evacuation of twenty-five pints of thick grumous fluid. Attempted extirpation but had to be abandoned. Cyst washed out with iodine and wound closed with drainage tube. Peritoneal cavity not opened. For many weeks a thick mustard-colored discharge.	Thick grumous fluid.	Recovery.	
33	Bantock.	37	F.	Taken violently ill with pain in stomach, fever, swelling of abdomen. Seven weeks later tapping necessitated. Over a gallon thick yellow fluid evacuated. Second tapping necessary.	After two tapplings a laparotomy was done. Attempt to cut out a fistulous tract in site of trocar opening led to accidental opening of cyst containing several pints of purulent fluid. Cyst washed out and treated exactly as in previous case.	Thick yellow fluid.	Recovery.	

TABLE OF CASES OF CYST OF THE URACHUS—Continued.

Case No.	Operator and Reference.	Age.	Sex.	History and Symptoms.	Treatment.	Character of Cyst Contents.	Result.	Remarks.
34	Tait. Reported by Byron Robinson, <i>ANNALS OF SURGERY</i> , 1891, XIV, p. 350.	17	F.	Fluctuating mass in lower abdomen and pelvis. Showed peculiar difference from ovarian and parovarian cyst. Only history given was that of irregular menstruation for eighteen months with poor health.	Laparotomy. Cyst wall which was very thick and brittle, incised. Could not be separated from its bed. Contents thick and pulaceous. Walls could not be collapsed. Cavity irrigated with iodine water, wound closed at first without drainage, but five days later suppuration began and circular drainage was then instituted.	Thick and pulaceous.	Recovery in six weeks.	
35	"	9	F.	History so much like preceding that description is omitted by author. History of supposed gastritis four weeks before, when swelling was first noticed. Then became very anæmic.	Laparotomy as last resort. (No mention of diagnosis at time.) Condition recognized during operation as cyst of urachus. Incision and evacuation of thick pus, irrigation, abdomen closed with drainage.	Pus.	Recovery.	
36	"	40	F.	Had been ill some time. Hard mass in abdomen.	Laparotomy. As usual no peritoneum found. Diagnosis of cyst of urachus. Wall cheesy and friable as were also contents. To the naked eye, condition was tuberculosis. Cavity irrigated with iodine, wound closed with a single glass drainage tube. First post-operative week was febrile.	Semi-solid and cheesy.	Recovery to surprise of Tait.	
37	"	17	F.	Never menstruated. Was thin and anæmic. For past six months ill and for most part of that period in bed. As is so often the case her general condition suggested tuberculosis. Diagnosis of urachal cyst made before operation and confirmed.	Laparotomy. Cyst filled with cheesy matter. Tait pronounced this case hopeless as he did the preceding one. As before he closed the wound, after irrigation, with a single drainage tube.	Cheesy.	Recovery from operation but when seen afterward was evidently succumbing to tuberculosis.	
38	Not one of Tait's but occurred in practice of a colleague of Dr. Robinson.	12	M.	Abdomen enlarged for months with evidences of peritonitis. Later evidences of a pelvic cyst, but no further diagnosis.	Laparotomy. Surgeon puzzled to find no peritoneum. Cyst incised with escape of pus and cheesy matter. Abdomen closed with silk and a glass drain left in.	Pus and cheesy matter.	Recovery.	

39	Robinson, as above.	10	M.	It is only stated that this case was a post-mortem specimen. No clinical particulars, nor is it stated whether the cyst or an operation for it had anything to do with the patient's death.		Death.
40	Dosseker Bruno Beitrage zur Klin Chirurgie 1893, X, p. 102.	43	F.	Four years before, after severe peritonitis became run down, with lancinating pains in right lower abdomen. Some months afterward, tumor palpable through vagina, to right of uterus regarded as ovarian cyst. Improved under vaginal douches, mud baths, etc., but in course of a year became worse. Tumor grew larger and attacks of pain occurred. Afterward, fever, vomiting, etc.	Laparotomy. Cyst accidentally opened as it adhered to parietes; exit of three or four litres of bloody fluid. Laborious attempts to dissect out cyst with rupture of wall in places. No pedicle. Cyst did not enter pelvis. Peritoneum not open. Silk sutures, drainage at lower angle. Healing by first intention.	Recovery.
41	Vanderveer, Medical and Surgical Reporter, 1899, LXI, p. 661.	20	F.	Unilateral fistula from birth. Irregular discharge, profuse at times. Getting worse for past two years. Discharge very offensive.	Incision of fistulous tract. Considerable sinus exposed. Diseased surfaces curetted and cavity packed.	Recovery in two or three months.
42	Vanderveer, Journal of Obstetrics, 1897, XXVI, p. 567.	Young	F.	Cyst not large, evidently fistulous.	Operation. No details.	Cured.
43	"	Young	F.	Cyst not large, evidently fistulous.	Operation. No details.	Recovery.
44	"			High fever and symptoms pointing to abscess.	Cyst completely enucleated.	Cured.
45	Ill. Transac-tions Am. Association Obstet. and Gynec., 1892, p. 238.		F.	Had noticed swelling of small size for about ten years. During pregnancy, it enlarged rapidly and at end of third month contained five litres of fluid.	Incision and drainage. Miscarriage two weeks later.	Recovery.
46	Ill. American Journal of Obstet., 1897, XXVI, p. 568.		F.	Urine entered cyst but no inflammation ensued.	Laparotomy. Extirpation. Started to ligate urachus at bladder, but changed mind, cut duct off short and applied Lambert suture.	Recovery.
47	C. A. L. Reed, Am. Journal of Obstet., 1897, XXXVI, p. 568.			Scanty notes. Says he has several cases but no allusion to others.	Attempted enucleation which he gave up when he found that peritoneum was being removed. He boldly removed this flap and to secure approximation, separated peritoneum for two inches back of incision.	Recovery.

TABLE OF CASES OF CYST OF THE URACHUS—Continued.

Case No.	Operator and Reference.	Age.	Sex.	History and Symptoms.	Treatment.	Character of Cyst Contents.	Result.	Remarks.
48	Newman, Glasgow Medical Journal, 1896, XLVI, p. 26.	39	M.	Admitted for pain in hypogastric region of four days' duration. Inability to urinate. Blood evacuated with catheter. Abdomen swollen, dull on percussion over hypogastrium. Swelling resembling a distended bladder. Improvement under expectant measures, but tenderness on pressure and fluctuation lead to intervention. Had a swelling in this locality so far back as he could remember.	Laparotomy. Accidental opening of cyst. Gelatinous contents having ammoniacal odor. Wall thin and smooth, extending from bladder to umbilicus. Cyst evacuated, flushed out and drained with tube, urine escaped into dressings through operation wounds, discontinuing after a month when wound closed.	Gelatinous contents of ammoniacal odor urine.	Recovery.	
49	Morgan, Lancet, 1896, II, p. 1154.	5	M.	No data except that it was a case of supposed peritonitis with no characteristic symptoms.	Cyst opened and it together with bladder were washed out. No attempt to dissect out cyst wall. Wound in cyst closed with double row of silk sutures, superficially placed. No mention of suppuration during operation, but abdominal wound discharged pus and urine for several days.		Recovery in one month.	
50	Carroll, Jane W., Buffalo Medical Journal, 1896, XXXV, p. 869.	34	F.	Recurrent bowel attacks for eleven years. Fever, pain, emaciation. Diagnosis of peritonitis made. When first seen had pain and soreness in right iliac region, tumor palpable. Recurring attacks of fever and pain while under observation.	Laparotomy. Cyst of urachus recognized with numerous adhesions. Dissected out and wound closed.		Recovery.	
51	Douglas, Am. Journal of Obstet., 1897, XXXVI, p. 477.	36	F.	18 months ago noticed swelling in lower abdomen, more marked to right, soft and painless. Grew slowly up to four months ago, then more rapidly. Digestive disturbances, cough and loss of flesh, later vomiting. Urine normal. Examination gave evidence pointing to ovarian cyst.	Laparotomy. Cyst exposed and aspirated, 25 pints clear fluid drawn off. Diagnosis of urachal cyst now made. Cyst very adherent, but after enucleated it without much hemorrhage. Peritoneal cavity not entered but peritoneum detached from abdominal wall for a considerable area. No attempt to suture it, trusting intra-abdominal pressure would fix it in place. Wound closed without drainage.	Clear fluid.	Death in 48 hours.	Gangrene of detached peritoneum and death due to sapraemia, shown at autopsy.

52	20	M.	<p>18 months before, after troubles of micturition, the urine being very cloudy, felt pain in umbilical region, which was also swollen. Soon after this, pus escaped at the navel and continued to do so at intervals. Bladder trouble became worse progressively. Patient found to have a gonorrheal cystitis, duration of infection could not be determined.</p>	<p>Cystitis treated first. In washing out bladder pus appeared at the navel. Attempted radical cure of fistula. The urachus dissected out. Shape of bladder abnormal (tubular). Fistulous tissue extirpated, bladder wound closed.</p>	Pus.	Recovery.
53	43	M.	<p>About a year ago hemorrhage from bladder which continued to recur. Tumor size of orange felt above symphysis. Trial puncture, evacuation of turbid, yellow thickish fluid. Cystoscopy revealed tumor of the bladder.</p>	<p>Laparotomy. Tumor intimately adherent behind to peritoneum. Lower pole dipped into bladder. Cyst and tumor both extirpated. Healing throughout by first intention. Diagnosis cancer of bladder complicating urachal cyst.</p>	Thick turbid yellow fluid.	Recovery.
54	59	F.	<p>A swelling low down in abdomen more to left side than right. Recurrent peritonitis, swelling of considerable size, no inflammation at first. Pain antedated tumor, going back nine months, while tumor was not noticed until seven months later. Diagnosis before operation was circumscribed peritoneal effusion.</p>	<p>Laparotomy. Cyst incised and emptied and washed out. Its wall adherent to intestines and omentum. Second cyst beneath first, not the bladder. Was tapped and then opened. Two cavities made into one, packed and drained. No urine escaped. Not entirely healed for six months.</p>	Inflammatory products.	Recovery.
55			<p>No history. It is only stated that diagnosis was not made before operation.</p>	<p>The cyst was the size of a pigeon's egg or less. Wall mostly thin, transparent, and contained thick yellowish fluid. Was evidently extirpated whole as shown in plate.</p>		
56			<p>No history.</p>	<p>Not so large as preceding (small nut). Walls thicker, filled with thick clear liquid. Extirpated as shown in accompanying plate.</p>	Thick clear fluid.	

TABLE OF CASES OF CYST OF THE URACHUS—Continued.

Case No.	Operator and Reference.	Age.	Sex.	History and Symptoms.	Treatment.	Character of Cyst Contents.	Result.	Remarks.
57	Matthais, Beitrage z. klin. Chirurg., 1904, XLII, p. 339.	48	M.	Came to Mikulicz's clinic in 1907. Six months before tension in lower abdominal region. Urine turbid, tenesmus of bladder. General health suffered for next three months. Patient then improved, but symptoms suddenly returned to vanish again for two months. Returned a second time. Suspicion of cancer of bladder. Sent to Mikulicz. Superficially placed firm tumor, not sharply outlined, below navel; slightly more to right of middle line. Adherent to abdominal wall. Diagnosis of persistent urachus. When urine contained abundance of pus, patient felt better. Tumor varied in size.	Laparotomy. Abdominal wall dissected from tumor. Latter adherent to vertex of bladder. Cyst laid open and found to contain old blood clots and pus. Cyst size of a billiard ball. Water injected into bladder did not escape through cyst. Tumor detached with resulting perforation of the bladder. Bladder sutured and external wound closed.	Old blood clots and pus.	Recovery but fistula in abdomen had not closed at time of discharge.	
58	Patel, Revue des mat. de la France, 1904, XXII, p. 77.	3	M.	Fluctuating abdominal subumbilical tumor in middle line adherent to umbilicus. Persistent incontinence of urine, for which advice was sought. No connection established between tumor and bladder. Cyst of urachus thought of, also diverticulum of intestines, former hypothesis favored.	Medium laparotomy. Tumor exposed. Anterior aspect covered by peritoneum, readily separated. Cyst incised. Wall seemed to be muscular. Clear albuminous fluid evacuated. Impossible to extirpate cyst. Wall sutured together as in case of Hydatid cyst of liver. Externally wound closed. As cavity communicated with bladder, a retention catheter was inserted and left five days.		Recovery.	
59	Joseph Price,	Young	F.	Pain but complicating other abdominal troubles in all but two cases. All were suppurated, four were diagnosed during, and two before, operation.	Excision and closure in four cases, opened and drained two.			
60	"	"	F.					
61	"	"	F.					
62	"	"	F.					
63	"	"	F.					
64	"	"	F.					
	Pers'l letter.							

65	William J. Mayo,		F.	Slowly growing tumor discovered during sections.	Excision.	Cure.
66	"		F.		"	Death.
67	"		M.		"	Malignant. Re-curred and died 11 mos. later.
68	Pers'l letter. Nicholas Sem.	45	F.	Swelling between umbilicus and pubes. Discovered during sections.	Excision.	Cure.
69	Pers'l letter. Edwin Martin.		M.	Fusiform, inflam. tumor. Diagnosed before operation.		
70	"		M.			
71	Pers'l letter. W. A. Smith.	36	F.	Discovered during operation.	Excision.	Cure.
72	Pers'l letter. Roswell Park,	39	.	Annoying discharge from umbilicus.	Excision.	Cure.
73	"	7	.		"	Cure.
74	"	2	.		No operation.	Cure.
75	Pers'l letter. J. F. Erdman,	Young	F.	Fixed tumor in abdominal wall.	Excision.	Cure.
76	"	Adult	F.			Cure.
77	"	Middle Age	M.			Cure.
78	Pers'l letter. Howard A. Kelly,	27	F.	Burning sensation on urination with increased frequency in micturition for one year previous to operation, in first case. Slight pressure about rectum for two years previous to operation, in second case. Swelling in lower abdomen, without pain, in third.	Excision.	Cure.
79	"	46	F.		Cyst grasped on its peritoneal surface, pulled out to develop a pedicle. This was snipped through with scissors. No sutures or ligatures needed.	Cure.
80	"	25	F.		Cyst of urachus removed along with a piece of its pedicle.	Cure.
	Pers'l letter.					Two were diagnosed before and one during an operation.

TABLE OF CASES OF CYST OF THE URACHUS—Continued.

Case No.	Operator and Reference.	Age.	Sex.	History and Symptoms.	Treatment.	Character of Cyst Contents.	Result.	Remarks.
81	DeForest Wil- lard,	Child	F.	Intermittent oozing of urine.	Plastic closure.		Cure.	
82	"	"	F.	Intermittent oozing of urine.	No operation.		Don't know.	
83	" Pers'l letter.	14	F.	Treated by family physician for two months for typhoid fever. Probably sepsis. When first seen had enormously large abdomen which had been distended for several weeks. The day previous to his first visit the umbilicus opened and several pints of pus discharged. No odor of urine and history gave no report of urinary discharge from umbilicus.	Wound in umbilicus enlarged and drained. The cavity healed after 3 months, and has since remained closed.	Pus.	Cure.	
84	E. Wyllys An- drews,	Young adult	}	All were small narrow sacks which gave no trouble and were accidentally discovered.	Treatment not stated.		Cure.	
85	"	Adult					Cure.	
86	" Pers'l letter.	"					Cure.	

The cases above tabulated represent the known clinical material as published up to this time, or at least all that a careful search revealed. The table contains in addition 28 cases which were secured by correspondence and which have not been previously reported (Cases 59 to 86).

The history of many of these cases as given is very meagre and some of them are of no clinical importance. I have, however, tabulated all of those secured by correspondence, although in most instances the data received is not sufficient to warrant a positive classification.

SEX AND AGE.

Of the 89 cases here tabulated, including the three of my own, there were twenty-one males, fifty-eight females, and seven in which sex was not stated.

That urachal cysts are more common in middle life (from 20 to 40 years), and that in adult life women are more frequently affected than men, is shown from the fact that in seventy-two cases where the age is given, thirty-four cases were between twenty and forty years of age. Twenty-nine of these were females and five males. Of fourteen cases under fifteen years of age an equal number were males and females, and of the remaining fifteen who were past forty, ten were females and five males. It was stated in five cases that the woman was pregnant at the time she presented herself for treatment.

HISTORY.

Perhaps the most constant factor in the history of this condition is a mass felt between the umbilicus and symphysis pubis, varying in size from a barely palpable mass to a very large tumor. The symptoms usually present are a feeling of illness, loss of flesh, pain, often fever, gastric disturbance, and indeed the appearance of a tubercular subject. In addition to these we have in 15 per cent. of cases a discharging sinus through the umbilicus.

Tait speaks of peculiarities in the percussion note.

Other phenomena resulting from attempts at diagnosis, bimanual palpation, tapping, etc., appear to be equivocal in character, excepting in the presence of polygonal epithelium in the sediment of the tapped fluid. This, if present, is said to be pathognomonic.

DIFFERENTIAL DIAGNOSIS.

This condition has been diagnosed as tubercular peritonitis, and to one who has not come in contact with urachal cyst it is a most pardonable error.

A large cyst of the urachus may be mistaken for a parovarian cyst or an ectopic gestation.

TREATMENT.

Tait's Technique is naturally depended upon largely in the treatment. Incision and drainage are the first essential. A large proportion of these cysts cannot be extirpated, and Tait used irrigation and mopping with iodine. In two of my cases I simply irrigated and drained, with good recovery.

The detached peritoneum is troublesome, but, as suggested by Douglas, may be sutured back to the parietes, the to omentum, or excised and spread over the gap.

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ON THE VALUE OF THE INDIGO-CARMIN TEST AS AN AID IN THE DIAGNOSIS OF PARTIAL AND TOTAL URETERAL OCCLUSIONS.

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Montefiore Home.

DURING the past year three cases of obstruction of the ureter came under my care, and as the technique employed in studying them proved very adequate and simple, I have brought together in this paper the most essential facts bearing on these cases and their diagnosis.

Cystoscopy and ureteral catheterization are considered our main reliance in establishing the diagnosis of the patency or obstruction of a ureter. With the former the ostium of the ureter can be studied and frequently the observer can detect the systole and diastole of this slit, as well as the emission of a small stream of urine. By means of the latter the examiner can frequently determine an obstruction and locate its site. Both these aids are very valuable, but, as will be seen in the following cases, they were much less valuable than would have been expected *a priori* from a theoretical consideration of the problems involved.

In my cases I have supplemented the cystoscopic examination and the ureteral catheterization with the use of indigo-carmin to determine the patency of the ureter, and the results obtained have at times contradicted my diagnosis based on simple cystoscopy and ureteral catheterization; at other times the use of this coloring matter has verified my previous diagnosis. In the hypodermic administration of indigo-carmin in sterile concentrated aqueous solution, I see a most valuable aid in the diagnosis of the condition under consideration. Its use clears up many erroneous conclusions and prevents

some of the grossest diagnostic blunders, as will be made very evident in the following three cases:

CASE I.—F., aged 45 years. Had been sick for 1½ years. She was treated at several institutions in this city, without obtaining relief. She was finally operated, to determine the nature of a thickening of the right iliac bone, which thickening extended well into the right iliac fossa. The microscopic report of an excised piece of this bone was sarcoma, as the operator informed me by letter. About 6 to 8 weeks after this exploration she came into my care at the Sydenham Hospital with a 5-inch scar running obliquely downward and forward from the right lumbar region into the right iliac fossa. Several deep sinuses persisted, and from these a moderate amount of clear fluid discharged. Examination of this fluid showed it was not urine. The iliac bone was markedly thickened. Her urine was negative. Her general condition was very poor, suggesting cachexia.¹

As I suspected there might be some ureteral or kidney condition underlying this marked thickening in the right iliac fossa, on November 16, 1905, cystoscopy and catheterization of the right ureter was done. The bladder was absolutely normal. There was no diastole and systole at the right ostium, and no stream of urine was seen coming from this ureter. Catheterization of the right ureter was easily performed, but one-half inch from the ostium the ureter was obstructed. A No. 7 F. catheter² was first used and then a No. 4 F. Both catheters were obstructed at the same level. Absolutely no urine escaped from the catheter while in place.

As far as I had investigated this case it seemed justifiable to conclude that I was dealing with an obstruction of the right ureter, and from the fact that there was no play at the right ureteral ostium, and that no jet was emitted, diagnosis of complete ureteral obstruction was indicated. To clear up matters more satisfactorily on November 24, 1905, a second cystoscopy and ureteral catheterization was done, with the identical results. At this examination I injected, hypodermatically, 30 minims of a concentrated aqueous indigo-carmin solution, and after allowing one-half hour to elapse I made a fresh cystoscopic examination. Much to my surprise I found that *from the right ureter a minute*

and exceedingly feeble jet of blue urine was discharged. From the left ureter a forceful and copious stream poured well into the bladder, with marked regularity.

This observation upset my original, apparently well-founded diagnosis of a complete right-sided ureteral obstruction. The discharge of the feeble minute stream from the right ureter absolutely demonstrated its patency and the small volume of the stream showed that the obstruction was sufficiently marked to permit of the passage of only small amounts of urine at a time.

Subsequently the patient was given the test of antisyphilitic treatment and with that her general condition improved markedly, the sinuses closed, and the greater part of the iliac bone thickening as well as the induration in the iliac fossa disappeared. To determine what if any effect this absorption of the diseased tissue had upon the patency of the right ureter, on February 5, 1906, another cystoscopy and ureteral catheterization was performed. The bladder was normal as before. No systolic and diastolic play was detected at the right ureteral ostium. The right ureter was then catheterized and a No. 5 F. was passed $8\frac{1}{2}$ inches into this ureter without the least difficulty. The urine obtained by means of this catheter was absolutely clear and normal in every particular.

Epicrisis.—*This case shows how easily one can be misled in the diagnosis of ureteral obstructions if one relies on the methods usually employed. Basing my views on them at the first examination, I thought I had to deal with a complete ureteral obstruction. By the use of indigo-carmin it was made very evident that this ureter was only partially occluded, which could not be determined in any other way either as readily or as simply. Moreover the size of the stained stream gave me some idea of the calibre of the stricture.*

CASE II.—M., aged 40 years. This patient I studied at the German Hospital. He came to the hospital for pyuria. His history gave no clew to the cause.

April 27, 1906, I examined his bladder and found that the mucosa was chronically diseased. At the right ureter I detected no play of the ostium and the same applied to the left ostium. The lips of the right ureteral ostium were slightly everted. No distinct stream was detected coming from either ureter. As

the right ostium alone showed something abnormal, and as patient's symptoms were more marked on this side, I catheterized this ureter. At $1\frac{1}{2}$ inches from the ostium both Nos. 8 and 5 F. were obstructed in their passage. I apparently had an obstruction of this ureter, probably due to stone. The use of indigo-carmin, employed as in Case I, was resorted to and the subsequent observation of the ureteral ostia confirmed my diagnosis of an obstruction and added the information that this obstruction was complete. The stream from the left ureter was voluminous, forceful and normal in every way, whereas absolutely no sign of a blue-colored stream appeared at the right ureteral ostium.

Epicrisis.—In this case the injection of indigo-carmin made it evident that the right ureter was completely blocked, which diagnosis would have been absolutely impossible without this aid. Thus the facts elicited by these combined methods demonstrated the position as well as the degree of obstruction. *Neither method employed alone would have given the same results. As a diseased kidney may fail to excrete, or excrete very late, indigo-carmin, without the use of the ureteral catheter one might be misled to diagnose complete ureteral obstruction in such cases, though the ureter be patent. Thus it is clear that one method does not exclude the other and that both must be used together. The ureteral catheter will arouse our suspicions of an obstruction and the indigo-carmin test will verify or dispel these.*

CASE III.—F., aged 25 years. Patient is six months pregnant, and came to the Sydenham Hospital for bladder trouble. She has pyuria.

May 11, 1906, cystoscopy showed a highly congested and inflamed mucosa, with very marked cedema of the neck of the bladder. The organ was markedly flattened anteroposteriorly by pressure of the pregnant uterus. The ureteral ostia were normal and showed absolutely no play or discharge of urine. Both ureters were readily catheterized. The catheter was obstructed in its passage in the right ureter about 5 inches from the ostium; in the left ureter it was obstructed at about $3\frac{1}{2}$ inches. Absolutely no urine was obtained from either catheter. Thinking the pregnant uterus might be pressing on the ureters, this organ was supported from the lumbar regions and drawn from the bladder, without result. Then the table was raised so

that patient's body was on an inclined plane, with pelvis raised; this was equally ineffectual. Patient was then placed in knee-chest position, and even in this position no urine flowed through the catheters. These manœuvres, however, seemed to indicate that the uterus was probably not the cause of the obstruction to the passage of the ureters.

The cystoscope (Nitze's double-catheter instrument) was then removed and after a fresh filling of the bladder a very rigid pair of ureteral catheters was employed. With these I succeeded in getting past the obstruction in the right ureter, but absolutely failed in the left ureter. The urine flowed very rapidly from the right ureter, so that I obtained some 20 ccm. in 6 to 7 minutes. This specimen was perfectly normal. The large amount of urine obtained showed a dilated condition of the pelvis and upper ureter.

A few days later I repeated the above examination, with identical results. After some trouble I obtained a copious discharge of normal urine from the pelvis of the right kidney, but failed absolutely on the left side. Meanwhile the pyuria was rapidly giving way to the systematic bladder lavage, so that there was no valid reason for further ureteral catheterization. As far as I had gone, it seemed justifiable to conclude that there were obstructions in both ureters. In the right the obstruction seemed slight, whereas in the left ureter it seemed absolute. Not satisfied with this result, and relying on the experience furnished by the two previous cases, on May 24, 1906, after an injection of indigo-carmin, I made another cystoscopic examination. To my great surprise, a copious, regular, forceful blue stream appeared at the left ureteral ostium. A short while thereafter a much more voluminous blue stream appeared from the right ureteral ostium. After this very voluminous discharge, a minute stream trickled out of the same ureter, as if it were squeezing out what had remained in the ureter by an aftercoming peristaltic wave—much as the descent of solids and fluids in the œsophagus. This very voluminous discharge was very irregular in point of time; while the left side was squirting two or three times a minute, the right side was absolutely quiescent for many minutes at a time.

Epicrisis.—In this case the indigo-carmin test cleared up the whole picture. It showed that the left ureter was absolutely patent and that the kidney was working well. On the right side

it indicated that there might be some distention of the ureteral tract as manifested by the enormous blue jet that was poured into the bladder, and it also showed that the obstruction was dynamic rather than organic.

The following conclusions seem justified by the experiences in the foregoing cases :

1. The cystoscopic study of the behavior of the ureteral orifices does not suffice for the diagnosis of ureteral obstructions.

2. The cystoscopic study of the ureteral jet, especially if the urine is normal, is equally insufficient.

3. Ureteral catheterization *per se* cannot determine for us the presence of ureteral obstruction.

4. Similarly the indigo-carmin test *per se* is as inadequate as ureteral catheterization *per se*, because though the ureter be patent indigo-carmin may not be excreted if the kidney under examination is diseased.

5. On the other hand in ureteral catheterization conjoined with the indigo-carmin test we have a very satisfactory method of determining the presence or absence of a ureteral obstruction as well as the degree of patency of the ureter, as shown in the above cases.

¹ Further details of her general condition are unnecessary as they have no bearing on the diagnostic points with which this paper is dealing.

² The catheters employed in these cases were fitted with lateral openings.

ARTERIOVENOUS ANASTOMOSIS.

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WHENEVER a new branch of surgery is entered upon a long time may be necessary before any one man can definitely decide from his own cases on its usefulness. Reports of isolated cases from different observers are here helpful. I therefore report the following case of arteriovenous anastomosis which is, I believe, one of the earliest, if not the first, in which the suggestion of Carrel and Guthrie¹ has been followed.

Dennis C., eighty years old, entered the service of Dr. George H. Monks, by whose kindness I was permitted to operate, at the Boston City Hospital the last of April, 1906. His history was of no special importance except that he had had heart trouble and had frozen his little toe the previous winter. He came to the hospital for gangrene of the middle toe of the right foot.

Physical Examination: Well developed and nourished. Heart, base second rib, apex in anterior axillary line under the sixth rib, loud systolic murmur transmitted to axilla. Pulmonary second sound accentuated. Lips blue. Radial arteries tortuous and all arteries markedly sclerotic. Abdomen negative. Left hydrocele. Middle toe right foot in condition of dry gangrene with œdema of foot to heel. No pulsation felt in dorsalis pedis. The urine was pale, acid, 1012, free from albumen, sugar or bile.

He was put upon appropriate treatment. The gangrene was kept dry but slowly progressed so that the middle toe sloughed off and the neighboring toes became involved in the process.

On May 10 under ether an arteriovenous anastomosis was done. The knee was flexed and the thigh rotated outward. An incision was made over the apex of Scarpa's triangle and carried down to the sartorius muscle, which was retracted outward. The

¹ ANNALS OF SURGERY, Feb., 1906.

sheath of the vessel was opened and the artery freed for about two and a-half inches. The vessel was decidedly sclerotic. The vein lying behind and slightly to the outer side was freed for a corresponding distance. This required ligation of two or three small branches. A Crile clamp was placed on the artery at the proximal end of the freed portion and a split piece of rubber tubing was used to control the circulation at the distal part. A Crile clamp was put on the distal portion of the vein and a rubber tourniquet on the proximal. The artery and vein were each divided, the vein at a slightly higher level than the artery to facilitate the first anastomosis. The proximal end of the artery was then invaginated into the distal end of the vein. Three double-headed mattress sutures, placed equally distant on the circumference of the artery, were passed through the wall from the inside out. The needles passed within the vein for about a quarter of an inch were pushed through its wall from inside out. When the sutures were tied the artery was invaginated into the vein. Interrupted sutures then caught the overlapping vein to the wall of the artery, the whole thickness of the latter not being included in the sutures. Pagenstecher's celluloid thread No. 1 was used for all these sutures. The distal control tourniquet was removed from the vein below the anastomosis and the Crile clamp from the artery above the anastomosis. There was absolutely no leaking at the joint. The vein promptly partially filled and pulsated slightly. By a similar proceeding the distal end of the artery was invaginated into the proximal end of the vein. As the vessels had been divided at slightly different levels to aid in the first anastomosis some tension was necessary to connect these ends. A small clot which had formed in the end of the artery was wiped out before the anastomosis was begun. During the manipulations of this anastomosis the controlling tourniquet was pulled off the lower end of the artery, allowing some blood to escape from the distal end of the artery before it was again controlled. This blood was very dark and corresponded exactly in appearance to venous blood. When the anastomosis was completed and the controlling clamp and tourniquet removed the vein partially filled. The sartorius was then allowed to resume its normal position. The superficial fascia was sutured with catgut and the skin with silk-worm-gut. A dry sterile dressing and a spica bandage were put

on, holding the thigh flexed on the body to relieve tension on the vessels. The patient was fastened to a Bradford frame with pillows under the knee. The recovery from ether was good.

At first I was disappointed in the result of the first anastomosis, by which arterial blood was delivered by the artery to the vein by the failure of the vein to pulsate forcibly and to fill out to its full extent. This, however, is hardly to be expected for the possible calibre of the vein is much greater than that of the artery and its non-elastic walls would not transmit the pulsation. The fact that blood of venous appearance was in the lower end of the artery at the time of the second anastomosis may be explained in one of two ways; either the arterial blood had had time to go round through the veins and was trying to return as venous blood through the lower part of the artery, or the blood had been kept stationary in this portion of the vessel long enough to change in appearance. The blood was not dark-colored from the cyanosis of overetherization, for the patient at no time during the operation was more than lightly etherized. The fact that the vein filled after the second anastomosis, where the portion of artery which was expected to return venous blood was connected with the proximal end of the vein, seemed to me of importance, showing, I thought, some back flow up the artery.

After the operation there was no immediate change in the appearance of the leg. Its temperature was fully as warm as that of the other leg and there was no œdema. Some who watched the case thought as time went on that the superficial veins became a little more prominent than before the operation. The correctness of this observation I question. The veins never pulsated. The incision in the thigh healed by first intention in spite of the fact that the patient frequently tore off the dressing. The gangrene spread very slowly until the front portion of the foot, roughly that anterior to the tarso-metatarsal joint, became involved and here a line of demarcation formed. The patient was shown in this condition to those members of the American Medical Association who visited the hospital clinics and it seemed to be possible at that time to make the following deductions: Inasmuch as the circulation in the leg before operation was sufficiently poor to permit gangrene of the toes, and inasmuch as the femoral artery had been divided in Scarpa's triangle thus permitting

collateral circulation only through the profunda, it was fair to suppose that very little blood would have reached the lower leg through the collateral circulation and that the gangrene would rapidly have involved the leg unless as a result of the operation the veins were carrying the arterial blood. As the leg presented none of the appearances common to an extremity from which the blood has been shut off, and as the gangrene extended only very slowly finally forming a line of demarcation at about the tarso-metatarsal joint, the operation was considered to have been successful.

Amputation of course was necessary to remove the gangrenous portion of the foot. As an amputation at the point of election on the leg was considered preferable to one through the foot the leg was cut off on June 8. The operation was done without any tourniquet. Both anterior and posterior tibial arteries contained arterial blood which spurted out from the cut ends with fairly good force. The veins did not appear to contain any arterial blood. There was a slight separation of the skin of the flaps which left a very narrow area to heal by granulation. This required a rather long time and the patient was discharged on August 6.

What the meaning of the findings at the amputation is I do not know, and whether it vitiates all the deductions made earlier I must leave undecided. The case is reported simply as a case and each may draw his own conclusions.

PROSTATECTOMY IN TWO STAGES:

A CONSERVATIVE OPERATION WITH MINIMUM HAZARD.

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It is not the object of this brief communication to present a novel operative technique or original method, but it is simply an observation of personal work performed during the past year in a class of cases of prostatic surgery which may be described as "bad risks," or those which go to make the mortality rate of any operator high.

Statistics of prostatic operations vary so widely, and opinions seem so to differ amongst many surgeons, that one is inclined to wonder what is the real consensus of opinion concerning the hazard of prostatectomy.

Each year this Association has listened to the splendid reports of its able members, and to the brilliant technique which has gradually reduced the mortality percentage of prostatectomy in the last decade at least at the rate of one per cent. per annum; yet it cannot be denied that in some cases it makes little difference how brilliant the operator or how perfect his technique, certain physical conditions exist which cannot be contended against.

Each case has its own personal equation comprehending the important features bearing upon it. Amongst these features of accepted importance we may cite the age and general vitality of the patient. It stands to reason that, other things being equal, statistics confined to patients seventy or eighty years old should show a relatively high degree of mortality. Again, the kidneys bear so important a relation to the immediate condition and future outlook of every prostatic about to be operated upon, that the greater the damage already to these organs

the less can they be expected to withstand any additional strain consequent upon operation.

The man who consumes a great deal of food without exercise runs to fat and has little resistive power generally, is a bad subject for infectious fevers, and likewise a poor subject for an operation of the nature of prostatectomy, on account of the resistance required against urinary absorption.

A man who, after a life of ease and comfort and self-indulgence, is visited in his advanced years by some great shock or business care of magnitude, has his resistive power much reduced by the trauma to his nervous system and is a poor surgical risk for prostatectomy.

If we sum up briefly the dangers and difficulties to be contended with in prostatic operations, as urinary suppression, secondary shock, and general toxemia, and in especially congested prostates—profuse hæmorrhage, the mortality rate or hazard should bear a more or less direct relation to the existence of these features in any given case.

No one will, by choice, operate in emergency; and it has been in connection with the emergency cases of prostatic surgery that I have been compelled to operate upon in the past five years that I have been impressed with the special value in these several instances of operating upon the prostate in two stages. So that for some time past it has become my practice, in a certain number of cases suggestive of high operative risk, to perform the work designedly in two separate stages rather than do a complete and radical removal at the first operation.

It has happened that within the past twelve months there have been about eight such cases, so severe in type and so threatening in character that in drawing statistics to determine the average rate of mortality they should be considered by themselves.

Yet the result in each instance has been so strikingly satisfactory that I have seen fit to select this theme for the subject of my communication to this Association, and submit these cases in evidence of the value of that particular kind of conservatism in the class of cases that they represent.

It may be claimed with some truth that several or all of these patients might have survived a radical operation in one step by suitable technique in the hands of a rapid and efficient operator; yet, as I scan the histories of these cases and reflect upon the personal impression gained at the time I analyzed the situation of each, I cannot but feel that had a different course been pursued, most, if not all, of them would have succumbed; and whereas, even if a few of them had not done so, the risk of radical primary operation would certainly have been greatly increased.

CASE I.



CASE 3.



The following is an abstract of the important features bearing upon the histories of each case:

CASE I.—D. D., aged 80. February, 1905. Usual symptoms of prostatism. *Urination.*—Every one-half to one and one-half hours, day and night. *Pain.*—During and after urination, and burning during exertion both in the glans penis and epipubic region. *Urine.*—Turbid, purulent, foul and ammoniacal.

General Condition.—Feeble and shows evidence of urinary toxemia,—tongue dry, breath fetid, etc.

Previous History.—Patient has never had complete retention, but has on several occasions attempted to relieve himself by the use of a catheter. His doctor states that his urine was perfectly clear up to six months ago.

Examination.—Prostate *per rectum* moderately enlarged. Urethral length, 7 inches. Residuum, 1½ oz. Search for stone, negative. Concentric, intravesical, moderate prostatic growth is felt with searcher.

February 8, first operation. Perineal cystotomy. Digital exploration finds a circular and symmetric prostatic growth. One galvano-cautery incision enlarging the vesical orifice, and a drainage tube inserted.

CASE 4.



February 17, second operation. Two portions of prostatic tissue the size of a large English walnut are removed through the perineal wound and prostatic urethra. Hæmorrhage promptly and effectually controlled with formaldehyd gelatin and packing.

Patient out of bed on third day after removal of prostate. On account of age convalescence is slow, but ultimate progress entirely satisfactory.

Last observation one year after operation. Patient empties bladder completely, retaining urine for from two to four hours, and is in excellent general health.

CASE II.—B. G., aged 53. May, 1905. Usual symptoms of

prostatism. *Urination*.—From one to two hours by day and five or six times at night. *Pain*.—Great smarting during and at the end of urination. *Urine*.—Turbid; purulent. Laboratory examination shows albumin in marked quantity and epithelial casts.

General Condition.—Poor. Patient is flabby and soft; takes no exercise; eats excessively; dyspeptic, constipated, neurotic.

Previous History.—Duration of trouble over ten years, beginning with stone in the bladder, with acute retention; since when symptoms have become gradually worse and kidney implication progressively increased.

Examination.—Prostate *per rectum* bilaterally enlarged; urethral length, 8 inches. Residuum, 3 ounces. Search for stone, negative. Searcher distinguishes moderate, intravesical abutment and a median bar.

May 8, first operation. Preliminary perineal drainage. Intravesical exploration feels a very tight urethral orifice and general circular hypertrophy of prostate.

May 15, second operation. Galvano-prostatotomy. Two cuts, one on each side, one centimeter in length. Hæmorrhage promptly and effectually controlled by formaldehyd gelatin and packing. Drainage renewed for three days. Patient leaves hospital at the end of two weeks. Ultimate progress satisfactory.

November 14, 1905.—Last observation, six months after operation. Patient empties bladder completely. The urine is opalescent but perfectly sweet. Urination every two to four hours. Still some albumin in urine. General condition much improved.

CASE III.—J. A. C., aged 79. November, 1905. Complete retention, which has existed for four years. Catheter has gone with increasing difficulty and size has been reduced until one with stylet has become necessary. Finally, for several days urethra has closed entirely and his attendant physician has been called in to relieve him by aspiration. *Urine*.—Muco-purulent; ammoniacal.

General Condition.—Poor. Pulse irregular; tongue coated.

Previous History.—As above stated, catheter life for four years; prior to which the usual symptoms of prostatism were in force.

Examination.—Prostate *per rectum* rounded, succulent, congested, about the size of a golf ball. Urethral length, 9 inches.

November 10, first operation. Preliminary perineal drainage. Patient stands operation poorly but reacts satisfactorily.

May 17 (one week later), second operation. Two large prostatic lobes removed through the granulating perineal wound, after preliminary galvano-cautery incision of vesical orifice, which is very tight. The obstruction in this case is found to be twofold—a tight vesical orifice and lateral compression of the prostatic urethra by the two lobes, which are removed. Hæmorrhage promptly and effectually controlled with formaldehyd gelatin and packing.

Seventeen hours after operation, patient is reading the daily paper. Four days later, tube removed and urination through perineal wound.

Seven days after operation patient is out of bed. Subsequent condition progressively satisfactory.

Last report, one year after operation. Patient urinates voluntarily without catheter at intervals from three to four hours; bladder empties perfectly without pain; general condition excellent.

CASE IV.—A. J., aged 77. December 8, 1905. Emergency case. Complete retention of urine; copious intravesical hæmorrhage caused by attempt at catheterism outside of hospital.

General Condition.—Great distress and pain, due to bladder distension. Pulse rapid and irregular.

Previous History.—Only previous attack of hæmorrhage one year ago, without apparent reason. Otherwise usual symptoms of prostatism, gradually increasing in intensity for years.

Examination.—Prostate *per rectum* much enlarged, rounded, tense, congested. Bladder felt above the pubis, reaching between it and the umbilicus.

Operation.—Suprapubic cystotomy late at night; bladder full of blood-clots and urine; great bleeding during operation from congested prostate. Bleeding recurs with great activity and, twenty-four hours later, tube inserted through perineal opening. Hæmorrhage is promptly and effectually controlled with formaldehyd gelatin and packing.

For two weeks following, condition very critical; patient is evidently toxemic. Kidneys, however, secrete freely; muttering, and at times violent delirium. The toxic state gradually improves and wounds develop healthy granulations.

December 29, three weeks after preliminary operation, perineal prostatectomy. A large amount of adenomatous tissue removed through perineum; hæmorrhage not great; reaction slight. Bladder drains by perineum and suprapubic wound closed. Packing out in forty-eight hours; patient out of bed at end of week. All urine comes through perineum by voluntary urination ten days after operation. Subsequent progress entirely satisfactory. Last report, five months after operation. Patient walking about the streets; urinates voluntarily without difficulty; empties bladder; general health entirely satisfactory.

CASE V.—J. W. A., aged 67. January, 1906. Usual symptoms of prostatism, with increasing irritability. *Urination.*—Every two hours day and night, with attacks of greatly-increasing frequency. *Pain.*—Smarting and irritability, associated with the urinary act and between times. *Urine.*—Turbid, purulent, sometimes ammoniacal. Bacteriuria, albumin and casts.

General Condition.—Medium. Patient is under a great nervous strain. Flesh soft and flabby; eats freely, and is dyspeptic and constipated.

Previous History.—For ten years there has been increasing evidence of vesical obstruction. The stream has gradually become smaller and urination more halting at the start.

Examination.—Prostate *per rectum* symmetrically and bilaterally large; urethral length $8\frac{1}{2}$ inches; residual urine 3 ounces. Search for stone, negative. Following search there is great increase in the bladder irritability, and decided constitutional disturbance in the shape of chill and fever, etc. The symptoms of vesical irritability and obstruction continue to increase progressively, with a varying degree of intensity. Operation determined upon. On account of the great mental depression and of the poor general physical condition the patient is regarded as a questionable risk, and it is decided to approach the operation in two stages.

February 15, 1906, preliminary perineal cystotomy. Hæmorrhage from the congested prostate is unusually marked. The perineal distance is very long and the patient is kept under operation only long enough to make out a symmetrically enlarged prostate encircling the bladder orifice and compressing the prostatic urethra. Although this preliminary procedure required but a few moments, the shock of anæsthetic and operation is most dis-

proportionately intense. A few hours after operation, the pulse drops suddenly from 100 to 60, becomes very feeble, and there is marked postoperative shock. The patient rallies under morphine and stimulants. Drainage instituted for one week.

CASE 5.



CASE 6.



February 22, second operation. Both lateral lobes and median isthmus are enucleated through prostatic urethra. Hæmorrhage promptly and effectually controlled by formaldehyd gelatin and packing. Perineal tube is reinserted. The shock from this secondary operation is as disproportionately slight as that after the first operation was disproportionately great. Perineal tube out in six days. Return to voluntary urination through urethra pursues the usual course. Bladder empties entirely. Irritability grows progressively less. Progress is delayed by the intervention of a swollen testicle due to catheterism. Some involuntary dribbling continues for a few weeks but later subsides.

Last report, two months after operations. Bladder empties perfectly. Urinary intervals three to four hours. Practically no irritability. General health markedly improved, and patient starts for European trip.

CASE VI.—W., aged 69. February, 1906. Usual symptoms

of prostatism. *Urination*.—Frequency and urgency; difficulty in starting stream; intervals from every one-half to every three hours by day and once or twice at night. *Pain*.—Pain and discomfort in testicles and perineum during urination. *Urine*.—Turbid and purulent; not ammoniacal.

General Condition.—Fairly good.

Previous History.—Retention two years ago, when catheter was used several times daily for two months.

Examination.—Prostate *per rectum* moderately large; urethral length 8 inches. Search for stone, negative; searcher arrested at vesical orifice by contracture or bar.

February 16, preliminary perineal drainage. Prostate uniformly enlarged; small middle lobe and bilateral hypertrophy.

February 23, two lateral lobes and median isthmus enucleated through the perineum. Hæmorrhage promptly and effectually controlled with formaldehyd gelatin and packing.

Patient up at end of week; out of hospital in two weeks. Subsequent progress satisfactory.

Last observation, two months after operation. Bladder empties perfectly. Urination slightly more frequent than normal, but intervals gradually increasing.

CASE VII.—J. G., aged 65. March, 1906. Usual symptoms of prostatism. *Urination*.—Great difficulty, frequency and urgency; every hour day and night, sometimes more frequent. *Pain*.—Not marked. *Urine*.—Turbid and purulent; not decomposed.

General Condition.—Corpulent, flabby, soft, lymphatic.

Previous History.—For four years the urinary difficulty had gradually grown and increased, the stream gradually becoming smaller and the sense of insufficient emptying of the bladder more evident. Latterly there had been nocturnal and diurnal incontinence.

Examination.—Prostate *per rectum* enlarged to triple the normal size; consistence, succulent and compressible. Urethral length 8 inches. Search for stone, negative. Bilateral intravesical encroachment of prostate; residuum 17½ ounces.

March 6, preliminary perineal section. Following this simple procedure the reaction was disproportionately great. There was much febrile disturbance. The patient passed through a critical

period for the first ten days following the perineal drainage, when it was out of the question to consider the second operation. The temperature ranged from 103° to 104° , accompanied at varying intervals by chill. Under bladder lavage and internal antiseptics the toxemic condition gradually subsided, but there continued to exist an evening rise in temperature.

March 20, two weeks after the primary operation, perineal prostatectomy was performed. Two large lateral lobes were removed through the prostatic urethra. Hæmorrhage promptly

CASE 7.

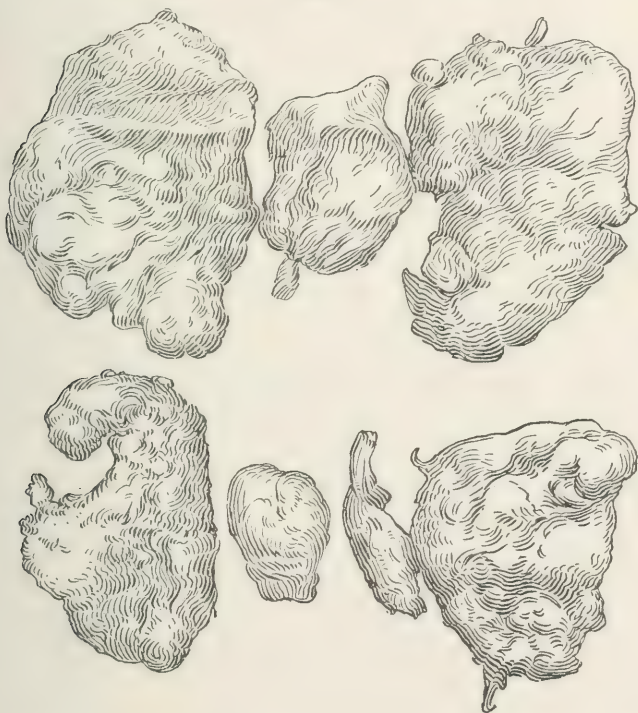


and effectually controlled by formaldehyd gelatin and packing. Immediate reaction very slight after this operation. Subsequently double orchitis occurred, confining the patient to bed for an unusually long period. The subsequent condition has been sluggish; the wound is healing very slowly, and in every phase of the case there is confirmatory evidence of the unsatisfactory material of the patient. Last observation, two months after operation. Patient is out of bed and about, but still in unsatisfactory general physical condition. Perineal wound has not entirely healed, and there remains some leakage between the urinary acts, which are about from one to two hours. Yet there is slow but progressive improvement of the bladder, the general

condition and the dribbling, and it would seem that ultimate recovery is only a question of time.

CASE VIII.—W. B., aged 70. April, 1906. Patient was brought to the hospital as an emergency case, having suffered outside the hospital for several days from retention, which had been relieved by aspiration. At the time of entrance bladder was greatly distended above the pubis and patient was suffering intensely. A catheter introduced by one of the assistant staff far

CASE 8.



enough to draw urine obtaining no return and being clogged with blood, further attempts had been discontinued.

General Condition.—Shows the evidences of urinary absorption. Tongue dry and coated, breath fetid.

Previous History.—Patient has shown the usual symptoms of prostatism for a number of years; the present is the first attack of retention.

Examination.—Urethral length uncertain. Prostate *per rectum* symmetrically enlarged, soft and resilient, giving the feel of the presenting body of waters during pregnancy.

Operation, April 24, 1906. Suprapubic incision, which closes infiltration of urine in the prevesical region, presumably from the aspirating puncture, as no rent in the vesical wall could be found. The bladder when opened is found full of blood-clots and urine. The bladder is tremendously engorged. Perineal opening is made for drainage.

Patient's subsequent condition is very bad. Toxemia marked. Delirium supervenes, and febrile condition continues for a week or ten days after operation. Blood examination shows secondary anemia.

May 7, two weeks after first operation, secondary operation. Prostate removed through perineal opening by the assistance of finger through the suprapubic wound. This is found very helpful, on account of the unusually long distance of the perineum. Hæmorrhage promptly and effectually controlled by formaldehyd gelatin and packing. On account of the occurrence following the first operation of right epididymo-orchitis, a vasectomy is performed at the same time as the second prostatic operation. Reaction after operation is very slight and the vesicle which, prior to vasectomy, had been tender and enlarged, shows immediate and progressive improvement.

Last observation, two weeks after operation. After-condition of the patient has been sluggish on account of his enfeebled condition. He is, however, daily improving. The suprapubic wound is healing progressively and leaks very little. All of the urine comes through the perineum. There has not as yet been any voluntary urination, but patient sits up out of bed and is daily regaining strength.

A summary of these cases shows that the ages of the patients were, respectively, as follows: 80, 53, 79, 77, 67, 69, 65, 70, the average being threescore years and ten. Two of them, in the neighborhood of 80 years, were exceedingly feeble, and were considered questionable risks on this score. One gave evidence of advanced renal implication. Three others were emergencies, in that they had for several days suffered from acute retention relieved by aspiration. One of these had infil-

tration of urine in the prevesical region and two of them intra-vesical hæmorrhage. Three other patients were soft, flabby, neurotic, and more or less broken down in health, and would be classified as poor surgical risks on this account. All of them were submitted to complete radical removal of the prostate, after preliminary drainage, with one exception, in which instance, on account of the serious kidney complication, the galvano-cautery technique was employed. All of them up to the present have done remarkably well, the last reports dating from several weeks to twelve months after operation.

In recalling the important features of these cases I would lay particular stress upon the great value of formaldehyd gelatin as a local hæmostatic. It is my custom to employ it after all perineal operations, and since its use I have never had serious hæmorrhage and believe that as a result, the postoperative condition has been more peaceful to the patients and less troublesome. The drainage by tube has been more continuous and unobstructed and, generally speaking, there has been great freedom from that very aggravating and disturbing feature of straining with attendant bleeding and clot-formation which, in my past experience, had made so many perineal cases during their postoperative stage arduous, vexatious and even alarming.

Further observation upon the secondary operation is the incontestable fact that the parts, owing to circulatory decongestion and granulation, are much more accessible and the line of cleavage between the prostatic tissue and the capsular surrounding more easily separated; hæmorrhage is unimportant; shock is trifling, the operative period being minimized to a few minutes; and, finally, that much-feared after-condition of post-operative toxemia is almost entirely eliminated, as the patient during the preliminary period of drainage has become inured by his own secretions and his normal resistance fortified by the hand of nature in advance of and in preparation for the concluding operative procedure.

THE FEMALE PROSTATE.

AN ANATOMICO-SURGICAL STUDY.

BY CHARLES E. BARNETT, M.D.,

OF FORT WAYNE, IND.

FROM the hypothesis that the prostate in the male arises as two separate glands, which are developments of the lining membrane of the first part of the urethra, instead of the Müllerian duct-coalescence-embryologic idea, gives the female the opportunity for a like glandular development. So in order to call a closer attention to the subject of the deep urethral (Skenes) glands of the female, I have dubbed them, in the title of this paper, the Female Prostate.

In substantiation of the claim "that the male prostate has an entirely distinct and different origin from that of the utriculus masculinus," and thus allowing, in the writer's opinion, the analogy between the male prostate and the female deep urethral glands, the following points in embryology are offered as evidence:

"In the male the utriculus masculinus (the coalesced Müllerian ducts) enters the back of the first part of the urethra (the uro-genital sinus) in the middle of the line, and the vasa deferentia (the Wolffian ducts) terminate, in the edge of the orifice of the utricle, on either side.

"In the female the vagina (the coalesced Müllerian ducts) enters the back of the vestibule (the uro-genital sinus) in the middle line, and the ducts of Gärtner (the Wolffian ducts) terminate in the lower part of the vagina on either side.

"The homology between the male prostatic utricle and the female uterus and vagina is a demonstrable fact.

"The male prostatic utricle and the female uterus and vagina have an origin distinct and different from that of the uro-genital sinus.

"The prostate glands are developed in the wall of the genito-urinary sinus, at a point farther from the bladder than the opening of the utricle. They are apparently mucous glands of the uro-genital sinus, and they consist, in the fourth month, of a few branching columns of cells which cluster together at the back of the urethra, where they are seen in two separate masses, one on each side of the middle line. At this stage they are entirely within the layer of voluntary muscle of the urethral wall, and do not form any visible projection. In the ninth month they are larger, more fully developed, and form visible projections; they are two separate and distinct glands, and have grown beyond the limits of the external wall of the urethra."—Richardson.

It would seem from a study in comparative anatomy that the prostate gland, Cowper's glands, and the vesiculæ seminales (glands)¹ furnish the culture media for the sperm cell in the male.

Would it be straining a point too far to consider the female accessory glands, viz., the deep urethral, Bartholin² and Nabothian as secreting a still further culture media for the spermatozoa,³ active if the male is passive and performing a greater function than a mere lubricant during coitus.

It is claimed as an undoubted fact that we have "the orgasm with discharge of semen in the male and the orgasm and reception of semen in the female." (Lydston.) The smaller mucous glands in the male are pouring out their fluid during the exciting stage of passion, we will say for the purpose

¹ Piersal finds glandular tissue in the vesiculæ seminales.

² The comparison between Cowper's glands and the glands of Bartholine is good. They both lie just below the bulb, within the triangular ligament, upon the levator ani or constrictor urethra muscle, as it is called, in this region. Their size and lengths of ducts are practically the same.

³ Stöhr's Hystology, Fifth Edition, says: "In this mixture of fluids (*i.e.*, spermatozoa plus vesicular, prostatic and Cowper's gland fluid) the motions may continue for from twenty-four to forty-eight hours after death, and for a still longer period in the secretions of the female genitalia. * * * * Acids suspend motion, while animal fluids of alkaline reaction restore motion." This would tend to show that there was a secondary flow in the female that was sufficiently alkaline to neutralize the ordinary acid vaginal mucus.

of lubrication, but not so with the larger ones until the orgasm occurs.

From the limited investigation that the writer has been able to make there is a like functioning condition present in the female, with the difference that the simple mucous primary flow is greater than in the male and the secondary special flow with orgasm is not so profuse.

Observations on the chemistry of semen have been so few and fragmentary in character that the writer was not surprised not to be able, after considerable search, to gain any information relative to the chemistry or physiology of the female accessory-glandular fluid.

The study of the anatomy of the bladder and bladder-appendages has never been more active than to-day, and it is not impossible that some things have been overlooked by our older anatomists on account of their non-importance heretofore.

The new anatomies are giving the deep urethral glands of the female a passing notice, while the older ones are silent on that subject. Our recent works on the surgery of the urogenital tract of the female are further advanced even than the more recent anatomies in their anatomic description. This shows that the subject courts farther investigation.

The writer has found, after having made a number of female bladder dissections (the last ones being made in Weichselbaum's Pathologic Laboratory in Vienna), that the deep urethral glands of the female were located midway between the neck of the bladder and the meatus urinarus externus; placed laterally to the urethra, above the vesico-vaginal fascia, and having ducts which empty just internal to the external meatus. When hypertrophic the gland encroached upon the bladder-neck, the changes in shape during hypertrophy being similar to the male prostate during its outcroppings of lobules. (See Fig 1.)

In the majority of gonorrhœas of the female the urethra is invaded. During this urethritis the deep urethral glands are constantly in danger. Should they become infected the pathology present is much similar to gonorrhœal prostatitis

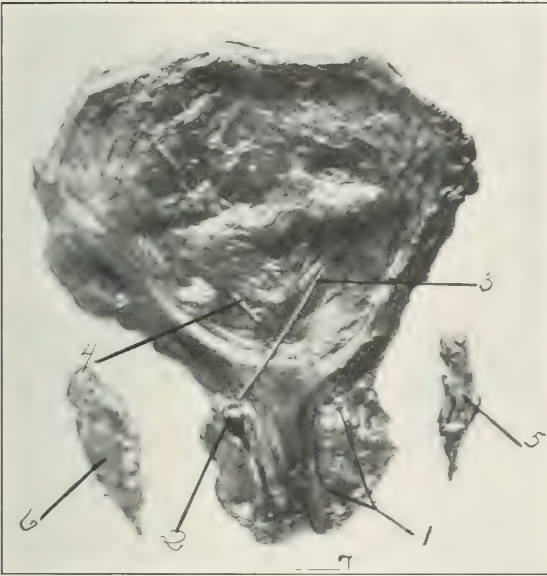


FIG. 1.—1, left hypertrophic gland; 2, right glandular lobule that acted as bolt valve in urethra; 3, wires sounding left urethral; 4, same in right urethral; 5 and 6, left and right hypertrophied gland of Bartholin; 7, tiny probe in duct of deep urethral gland.

in the male. Should pus form and the abscess break, the solution of continuity will either be toward the urethra or toward the vagina. Should the vaginal route be taken, there is great danger of an urethro-vaginal fistula, which is practically a vesico-vaginal fistula.

The vesico-vaginal fascia is so thin and so lacking in tone quality that an abscess penetration of it is effected with no great effort. Should the urethra remain competent the drainage opening will close and the abscess will reform *ad libitum* until surgical help is called. Should this infection be not sufficiently virulent to produce a breaking down of the tissues, there will remain a passive inflammation that by the stimulating effect within the acinus will produce an hypertrophy of the glands.⁴

The usual cases come late to the surgeon. Should there be sufficient time to abort suppuration, the best procedure, in the writer's opinion, is to slit the ducts to the glands and cauterize the field with silver nitrate.

If suppuration is present, the abscess should be opened from the vaginal side and properly drained. After resolution has taken place if any glandular remnants remain they should be taken away during the interval between the inflammatory crises, thus giving the operator a chance to avoid urethro-vaginal fistula. In case of urethro-glandular fistula, cauterization of the fistulous tract and abscess cavity should be done, followed by an interval operation, if possible, after the urethra has healed.

In vesico-vaginal fistula a plastic operation with the removal of all glandular remnants is indicated.

In all of these cases the bladder-neck will be found inflamed and will need attention.

The writer sees no reason why hypertrophy should need surgical attention unless it should happen to be like the case illustrated. Even with that condition present, the Fenwick

⁴ See writer's article on Pathologic Changes Resulting from Prostatic Enlargement. American Medicine, April 8, 1905.

operation (with the large urethral specula for the removal of papillomatous growths in the bladder) could be utilized for the removal of the glandular lobule.

The report of three cases will give an idea of the kind of cases encountered by the surgeon that are due to inflammation of these glands:

CASE I.—Mrs. "X." Operated by the writer several years ago for kidney stone, with recovery. About a year following operation she was infected by her husband with gonorrhœa. On account of her innocence and unsuspecting disposition the writer was called late, and consequently got the sequela of the disease, which in this case was an acute adenitis of the deep urethral glands. Under treatment the inflammation subsided to a marked degree, leaving a passive inflammation with tenderness and some enlargement in that region. An operation for the removal of the glands was suggested, which was declined by the patient. The fact is the patient is not aware of the cause of her trouble, and, unfortunately for the writer, considers that it is a remnant of her old kidney trouble.

CASE II.—In consultation with a doctor of our city, Miss "Y." was examined. She gave a history of acute inflammation at the neck of the bladder; emphatically denied gonorrhœal infection. She was ordered to the hospital, where a vaginal examination was made, at which time a slide was smeared with pus milked from the deep urethral glands. The pus contained Nisserian diplococci; a cystoscopy was done the next day; neck of the bladder found highly congested; bladder washed and neck painted with silver nitrate; ducts of glands slit and cauterized with silver nitrate. Two weeks after leaving the hospital there was a recurrence of the adenitis, with suppuration. A cutting operation for drainage, followed by the removal of the glands, during interval, was suggested—which suggestion caused the discharge of both the attending physician and the writer. From us she passed to the care of a thoroughly competent practitioner, who called in a surgeon, who was also thoroughly competent, but they failed to find the true cause of the trouble, and from these men the patient has drifted until finally on account of their flowery promises, she has been attracted to the Osteopaths and the Chris-

tian Scientists. As this disease is entirely out of their spheres, the writer would not be surprised, at no distant date, to have the patient return for the surgical relief that was advised in the beginning.

CASE III.—Was called to Detroit to see Mrs "Z.", who gave a history of infection of deep urethral glands seven years ago, which was followed with abscess formation. Vesico-vaginal fistula followed the breaking of the abscess, leaving an opening larger than would admit one finger. She had been operated five or six times by competent surgeons for closure of fistula, with negative results.

The writer proposes, in endeavoring to close the fistula, in this case, to do a suprapubic cystotomy in two sittings. After cleaning the bladder thoroughly, to freshen the edges of the fistula, close same tightly with chromicised catgut, then cover over the whole fistulous region with a flap composed principally of the bulb of the vagina, patient being put to bed, lying on her belly, in order to drain the urine away from the wound. Should the closure be complete a urethral canal will be tunneled at another sitting.

TERATOMATA OF THE INGUINOSCROTAL REGION.¹

INCLUDING A REVIEW OF REPORTED CASES.

BY DAVID C. HILTON, M.D.,
OF LINCOLN, NEBRASKA.

TERATOMATA are tumors of peculiar mixed histologic composition. Every class of tumor is composed of a single representative tissue-element, derived in embryo from one of the germinal layers,—epiblast, hypoblast, or mesoblast.

Teratomata are described by several authors as tumors containing tissues, organs, or systems of organs, derived from two or all of the germ-layers, the highest type being a fœtus in fœtu. In such tumors we may expect to find epidermis and its appendages, squamous mucous membrane, teeth and nerve elements, etc., representing the epiblast; bone, cartilage, connective tissue, muscle, etc., representing the mesoblast; columnar and ciliated epithelium in gland or membrane formation, representing the hypoblast.

Many tumors classified as teratomata, however, do not correspond in embryologic origin or in histologic composition to this description.

As to embryologic origin, many dermoid and other cysts commonly classified as teratomata take their origin from one germ-layer only, instead of from two or all of these layers. For instance, dermoid cysts whose wall is essentially composed of epidermis, hair, nail, epidermal glands, and teeth, and whose content is made up of epidermal detritus and gland secretions, are epiblast in origin, and possess no representative of the other two germ-layers, unless the connective or areolar tissue-layer external and contiguous to the epidermal structure is an essential part of the neoplasm. This connective-tissue layer as an increment to the cyst-wall has not been dem-

¹ Read before the Nebraska State Medical Society, May 3, 1906.

onstrated to be neoplastic in origin or growth. It appears to be adjacent tissue that has become displaced, rearranged, and adherent to the cyst-tissue proper during its actual growth. Many echinococcus cysts possess a similar connective-tissue layer which is not of the parasite, but of the adjacent tissue of the host.

As to histological composition, many dermoid and other cysts classified as teratomata present no complex of tissue elements. For instance, some dermoids are described as being composed of epidermis, there being no other tissue-elements from the epiblast or other germ-layers.

The series of teratomata herein set forth includes twenty-six dermoid cysts, which, according to descriptions of contents, are strictly ectoblastic in origin, containing epidermis and its appendages, and sometimes teeth. Also two cases of sebaceous cystomata appear, representing a differentiated type of epidermal cell, a simple tissue-element.

Only recently have anatomists and surgeons turned their attention to this form of tumor.

According to A. Pabeuf (03), the first mention of such a tumor was made in the year 1666. Verneuil states that Duverney described at that time a "mass in the testicle which had the form of a fœtus." Another supposed case was attributed to Schroekius Brothers. The first thoroughly authentic case, however, was a teratoma of the right testicle, the size of a cocoanut, containing "bone, cartilage, oil, and flesh," reported orally by St. Donat in 1697. To Geoffrey St. Hilaire the credit is due of having placed the study of these peculiar neoplasms upon a scientific basis, in the early part of the last century, by proposing the abdominal-inclusion theory as an explanatory hypothesis. The number of reported cases has not been completely enumerated in previous reviews of the literature. Kocher made a report of fourteen cases of scrotal teratomata, and Pabeuf (03) of forty-seven cases of scrotal and testicular teratomata. I have collected seventy-nine cases from the inguinoscrotal region, excluding doubtful cases reported before 1697.

The distribution of the reports in time is as follows:

1600—1700	1
1700—1800	0
1800—1850	9
1850—1890	23
1890—1906	46

It is noteworthy that seventy-five per cent. of all recorded cases have been reported within the last twenty-five years. This is accounted for in the rise and popularization of aseptic surgery, coincident with which more of this class of patients have sought a radical cure.

The point of origin may be referred in forty cases to a testicle; in twenty-one, to the scrotum; in fourteen, to the inguinal canal or cord; and in one, to the tunica vaginalis testis. In three cases, the point of origin cannot be ascertained. In cases wherein the tumor invaded two or more groups of tissues, those parts which are the more dependent or are continuous with more compact tissues by layers of fascia, are taken to be secondarily invaded. On the contrary, the less dependent, more compactly constituted tissues are taken to be the point of origin or primarily-invaded area.

The size of the tumors varies considerably. The majority of them are not larger than a hen's egg. The largest recorded size is 22 by 23 cm.; the smallest is 1 by 1.2 cm. In several instances no size is definitely recorded.

The age of the patients presenting these tumors is distributed promiscuously from five months to sixty-four years.

The diagnosis of these tumors is usually comparatively easy, but sometimes very difficult. As to physical consistency, on palpation they are firm, or soft and doughy, depending on the character and quantity of contents. They are, with few exceptions, cysts. Some contain fluid substance—*i.e.*, oil secreted by sebaceous glands. Others contain solids or solid particles mingled with a varying amount of fluid, making a mealy bran-like mass, which is doughy and inelastic, pitting on pressure. The solid material is desquamated epithelium, hair, and sometimes teeth, cartilage, and bone.

With the exception of sebaceous cysts, which are often multiple in or adjacent to the integument along the median raphe of the perinoscrotal region, the tumors are usually single.

As to differential diagnosis we have to distinguish them from other neoplasms benign and malignant, from parasitic cysts such as cysticercus, from granulomatous masses such as syphilitic, tubercular and actinomycotic swellings, from serous and sanguinous exudates such as hydrocele, hæmatocele, and hæmatoma of the tunica vaginalis testis, scrotum, or spermatic cord, from suppurative inflammatory swellings, and from inguinal hernia.

From among those pathologic conditions that may simulate teratomatous cysts I shall select two for detailed consideration, viz., inguinal hernia and hydrocele of the spermatic cord. Cystic teratomata invading the inguinal canal may be very difficult to differentiate from the two conditions mentioned.

As to herniæ: those which are completely reducible or tympanitic on percussion because of gas present in the contained bowel are not to be confused with teratomata. On the other hand, herniæ not completely reducible and containing omentum may resemble in detail teratomatous tumors of the type of dermoid cysts. On inspection, both form rounded swellings dilating the external inguinal ring. On palpation, both have a peculiar doughy feeling, being soft, and pitting on pressure. Dermoids are of more uniform consistency, however, herniæ containing omentum often exhibiting firm nodules in the general mass. Dermoids, containing mostly fluid, are firm and elastic and of uniform consistency, thus differing from the type of hernia under consideration. On percussion, both reveal dulness. Thus we may find signs on examination very similar in both conditions.

The history usually reveals a difference in the development of the two conditions. Irreducible or partially reducible herniæ usually give a history of former reducibility. In case of dermoids, the tumor is never actually reducible. The patient may say that it is or has been reducible, because displacement of the swelling upwards and inwards with the finger past the ex-

ternal inguinal ring has been possible. My patient was very positive that he could formerly reduce the swelling.

As to hydrocele of the cord, we have a lesion that may resemble a cystic teratoma containing fluid.

The details of differential diagnosis may be succinctly put as follows:

History.—Hernia. Slowly developed (excepting congenital hernia). Development from above downward. Gradual increase in size. Common to all ages. Reduction of mass through inguinal canal possible in early course, if not at time of examination.

Teratoma of Inguinal Region.—Same as above, except that complete reduction is never possible. History of reducibility of the tumor may be given, because in some cases the tumor can be displaced upward through the external inguinal ring.

Hydrocele of the Cord. Same as above. Reduction impossible. Moves with cord.

Inspection.—Hernia. Smooth, rounded mass, bulging the external ring. If reducible, may be seen to disappear through the external ring.

Teratoma of Inguinal Region.—Similar in appearance and position. Seen to partially disappear on pseudo-reduction, in favorable cases.

Hydrocele of the Cord.—Smooth, rounded mass on the cord. Does not disappear on attempted reduction.

Palpation.—Hernia. Such as contain intestine are even, and may be soft or somewhat elastic, due to gas in the bowel-loops. Tremor imparted by movement of gas may be discernible.

Such as contain omentum and other solid structures are soft, even, or lumpy and inelastic, pitting on pressure. Testicle is below the swelling.

Teratoma of Inguinal Region.—Similar to hernia containing omentum.

Hydrocele of the Cord.—Firm or fluctuating, even consistency. Attached to the cord.

Auscultation.—Hernia. Movement of gas may be audible.

Teratoma.—Negative.

Hydrocele of the Cord.—Negative.

The treatment of these tumors is complete extirpation of the cyst and its contents, under aseptic conditions; or, if the tumor has become infected, antiseptic measures and postoperative drainage of the field of operation is necessary. If the growth of the tumor has displaced any of the structures making up the supports of the inguinal canal, they should be dealt with as in operation for hernia, with a view of leaving the inguinal region well supported as a prophylactic against hernia.

Report of Author's Case.—The following case came under my care in June, 1905:

Mr. F. G. H., 32 years of age, American by birth, and a pastor by occupation, had since his fourth year noticed an enlargement occupying the right inguinal region, and secondarily invading the scrotum. He described it as having been very small at first, and reducible like an inguinal hernia may be, until recent years. He supposed it to be a "rupture." It had been diagnosed as "rupture" and as "hydrocele of the cord" by different surgeons. Its presence had not apparently affected his general health, and its growth had been slow. Of recent years, on account of its size, it had interfered with the performance of certain kinds of manual labor in which he had engaged.

One night while walking briskly along a dark street he came violently against a post, the brunt of the impact having been received over the swelling. He immediately became faint and nauseated, and felt a sudden downward motion as of something from above pushing into the scrotum on the right side. The pain subsided within a few minutes, and he presented himself at my house in a state of anxiety, having walked several blocks from the scene of the accident.

On inspection, the inguinal canal and scrotum on the right side were found to be occupied by an enlargement as great as a large coconut. It was rounded in outline, longer from above downward than transversely, and narrowest where it entered the external inguinal ring. The skin covering it was tense, and

spotted with petechiæ due to subcutaneous extravasation of blood sustained in the accident. It was not translucent.

On palpation, the whole mass was doughy, pitted on pressure, and exhibited an uneven, lumpy consistency, as of a soft mass occupied by more resistant bodies. Reduction was impossible, although some of the contents could be pushed upward through the external inguinal ring. The testicle was behind the enlargement.

Percussion revealed uniform flatness, and auscultation was negative.

The patient was confident that while the enlargement was being manipulated with a view of reducing a possible hernia, something slipped back out of the scrotum, but this was not at all clear to me.

On the following morning I operated. The technique was essentially that of the Ferguson operation for inguinal hernia. A semilunar skin incision was made, circumventing the right internal inguinal ring above, and in this instance continuing downward past the spine of the pubes, and over the pendant portion of the tumor. The skin and both layers of superficial fascia were reflected downward, exposing the inner and outer pillars of the external inguinal ring. The wall of the cyst resembled in appearance a thickened hernial sac.

Another incision was made through the external inguinal ring and intercolumnar fascia parallel with the aponeurotic fibres of the external oblique muscle, far beyond the internal inguinal ring. Upon retracting the aponeurosis, the inguinal canal was exposed and found to be occupied by its usual contents and the tumor mass. The cyst-wall had its highest attachment by firm adhesions to the structure forming the inner boundary of the internal inguinal ring, viz., that portion of transversalis fascia occupying the space between the internal inguinal ring and its line of attachment to the pubes behind the conjoined tendon.

The tumor was removed in its entirety and the supports of the inguinal canal, which had been considerably displaced by the presence of the cyst, were dealt with as in the Ferguson operation for inguinal hernia. In the scrotum, the large blood-clot, that had accumulated following the accident, was removed. Uneventful recovery followed the operation.

TABULATION OF REPORTED CASES.

Location of Tumor.	Size.	Contents.	Treatment.	Age of Patient.
Testicle, right.	2½ x 3 cm.	Teeth, Osseous Tissue, Hair.	Excision.	Child.
Scrotum.	Almond.	Corneal Desquamation. Fluid.	Removal. Recovery	35 yrs.
Scrotum.	Lemon.		Extirpation.	21 yrs.
Scrotum.	Hen's egg.	Sebaceous material.	Iodine injection.	30 yrs.
Testicle, right.	Fist.	Teeth. Adipose. Epithelium.	Castration.	38 yrs.
Testicle, right.	Hen's egg.	Sebaceous fluid. Cartilage. Granular material.		14 yrs.
Testicle, right.		Yellow fluid. Connective tissue.	Operation.	40 yrs.
Testicle, left.	10½ x 9 x 7 cm.	Mucilaginous fluid. Cartilage. Epithelium.	Castration.	29 yrs.
	9 x 7 x 7 cm.	Epithelial cells.		
Testicle, right.	Hen's egg.	Hair. Sebaceous material. Cartilage.	Removal.	1 yr.
Testicle, right.	Orange.	Horny material. Cartilage. Epithelium.	Castration. Recovery.	27 yrs.
Tunica Vaginalis testis.		Sebaceous and teratomatous material.	Excision. Cure.	11 yrs.
Scrotum.	Large.	Hair. Small bones.	Excision. Recovery.	20 mos.
Scrotum and inguinal region.	2 x 2½ inches.	Bone. Calcareous concretions.	Removal. Recovery	64 yrs.
Inguinal region and scrotum.	Plum.	Hair. Granular substance.		37 yrs.
Testicle, right.	26 x 27 cm.		Castration. Recovery.	33 yrs.
Testicle.	1 x ¾ inches.	Hair. Fat. Cartilage. Bone.	Excision.	8 yrs.
Testicle, left.	Orange.	Hair. Cartilage. Fat. Watery gelatinous substance.	Extirpation	35 yrs.
			Castration.	2 y. 6 m.
Scrotum.	2½ x 5 inches.	Fœtal parts.	Excision. Recovery.	Child.
Inguino-scrotal region, l.	1 x 1½ cm.	Epithelium. Cartilage.	Volkmann's Operation, for chronic hydrocele.	16 yrs.
Scrotum.	1½ x 2½ cm.	Hair. Mucoïd fatty fluid. Sweat glands.	Extirpation. Cure.	34 yrs.
Testicle, right.	Large.	Osseous material.	Removal.	8 mos.
Testicle.	14½ x 15½ x 12½ cm.	Epithelium.	Removal.	47 yrs.
Testicle, left.	2½ x 2½ inches.	Hair. Bone.	Extirpation. Recovery.	2 yrs.
Testicle and cord, right.	Goose egg.	Bone. Epithelium. Elements.	Castration.	48 yrs.
Testicle, right.		Fatty fluid. Nerve tissue.		32 yrs.
Scrotum.	Cocoanut.	Hair. Cartilage.	Castration. Recovery.	42 yrs.
Inguinal canal.	Hen's egg.	Sebaceous material. Hair.	Removal. Recovery	34 yrs.

TABULATION OF REPORTED CASES.

Location of Tumor.	Size.	Contents.	Treatment.	Age of Patient.
Scrotum, right.	Plum.	Creamy material. Hair.	Removal. Recovery	20 yrs.
Testicle, right.			Removal.	27 yrs.
Testicle, right.			Removal.	27 yrs.
Scrotum, left half.	3 x 4 cm.	Hair. Teeth. Bone.		25 yrs.
Testicle, right.	5 x 5.5 x 8 cm.	Epithelium. Cartilage.		25 yrs.
Testicle, right.	5 cm.	Hair. Sebaceous glands. Bone. Fat.	Operation.	8 yrs.
Scrotum, median line.	1 x 3 cm. 2 tumors.	Sebaceous and sweat glands. Epithelium. Oil.	Removal.	22 yrs.
Perineo-scrotal raphe, l.		Hair. Sweat glands.	Removal. Recovery	32 yrs.
Testicle, left.	Plum.	Epithelium. Muscle. Cartilage.	Castration.	27 yrs.
Testicle.		Dermoid.		
Scrotum, right.	Plum.	Bony and granular material. Muscle.	Extirpation.	18 mos.
Scrotum and inguinal canal.	Hen's egg.	?		2 yrs.
Testicle, right.	Extended to knee.	Fœtal parts.	Ligation of ring, Cure.	6 mos.
Scrotum, right.	15 x 18 cm.	Mucous and sebaceous glands. Hair. Cartilage.	Operation. Recovery.	18 yrs.
Scrotum, right.	6 x 3 inches.	Hair. Glairy fluid.	Excision. Cure.	15 yrs.
Scrotum and Hernia.	24 x 28 inches, 14 lbs.	Epithelium. Fat. Cartilage. Hair.	Removal. Cure.	60 yrs.
Testicle, right.	Orange.	Yellow gelatinous fluid. Elastic fibres.	Extirpation.	6 mos.
Perineo-scrotal raphe.	9 small tumors.	Described as dermoids.		23 yrs.
Perineo-scrotal raphe.	4 small tumors.	Described as dermoids.		29 yrs.
Testicle, left.	Turkey egg.	Hair. Sebaceous material. Teeth.	Removal.	11 yrs.
Testicle, right.	Goose egg.	Hair. Sebaceous material. Teeth.	Castration. Recovery.	12 yrs.
Testicle, right.	Fist.	Hair. Pus.	Excision.	22 yrs.
Testicle.	2 fist.	Hair. Sebaceous material. Teeth. Sudoriferous glands.	Operation.	66 yrs.
Scrotum and Testicle, l.	Hen's egg.	Epithelial glands. Fluid. Cartilage.	Excision.	16 yrs.
Testicle, right.	2 fist.	Hair. Epithelium. Sebaceous glands. Fibrous tissue.	Castration. Recovery.	18 yrs.
Testicle, left.		Putty-like material. Hair.	Removal.	
Testicle and Cord, left.	2 testes.	Detritus. Bony tissue. Fat.	Extirpation.	73 yrs.
Testicle, right.		Dermoid. Bony deposit.		26 yrs

TABULATION OF REPORTED CASES.

Location of Tumor.	Size.	Contents.	Treatment.	Age of Patient.
Inguinal Canal and Scrotum.	Very large.	Parts of fœtus.	Abscess formation, Recovery.	
Similar to preceeding.	Very large.	Parts of fœtus.	Abscess formation, Recovery.	
Perineal-scrotal raphe.	Almond.	Epithelial detritus. Papillæ. Pus. Sebaceous material.	Ablation. Recovery.	29 yrs.
Inguinal Canal and Scrotum, right.	Hen's egg.	Hair and epithelium.	Operation.	31 yrs.
Testicle, left.		Epithelium. Cartilage. Fat.	Excision.	49 yrs.
Testicle, left.	Cocoanut.	Bone. Cartilage. Oil. Flesh.	Excision.	V. Man.
Inguinal Canal.	Extensive.	Bone. Etc.	Excision.	47 yrs.
Testicle, left.	8 x 11 cm.	Epithelial pearls and muscle.	Removal.	43 yrs.
Testicle and Cord, left.	2 x natural	Epithelium. Cholestromatous material.	Castration. Cure.	28 yrs.
Testicle, left.	12 x 18 cm.	Fibrous tissue Cartilage. Muscle.	Castration. Death in 6 months.	51 yrs.
Testicle, right.	Fist.	Sebaceous material. Hair. Cartilage. Horny fragments.	Excision. Death.	27 yrs.
Testicle, left.	22 x 23 cm.	Cartilage and Cheesy material.	Castration. Unsatisfactory.	28 yrs.
Testicle, left.	6 x 12.	Epithelium. Hair. Sweat glands.	Excision.	
Testicle, left.	3 x natural.		Excision.	39 yrs.
Testicle, left.	5 x 8 cm.	Sebaceous material. Cartilage.	Castration. Recovery.	21 yrs.
Testicle, right.	Fist.	Teeth. Osseous material. Hair.	Excision. Infection. Death.	27 yrs.
Scrotum.	Hen's egg.	Hair. Cartilage. Fat.	Castration. Recovery.	2 yrs.
Scrotum,	Multiple.	Cyst.		
Scrotum.	Very large.	Bones comparable to ribs, vertebræ, femur.		
Scrotum, right.	Very large.	Bones of inferior extremities. Muscle.	Excision.	5 mos.

TABULATION OF REGION OF DISTRIBUTION OF TUMORS.

Organ Involved.	Primary Invasion.	Secondary Invasion.	Total Times Invaded.
Testicle, right	21	1	22
Testicle, left	15	2	17
Undesignated Testicle	4	0	4
Scrotum	21	9	30
Inguinal Canal and Scrotum	13	0	13*
Tunica Vaginalis	1	0	1
Unspecified	3	0	3

Total, 78. Plus Author's Case, 79.

* Plus Author's Case, 14.

The cyst-wall was found to be made up of epithelium, sudoriferous and sebaceous glands, and to be scantily lined by fine, light brown, lanugo hair. The content was a mealy mass of epidermal detritus and gland secretion. External to the epidermal lining of the cyst was a contiguous layer of fibrous tissue.

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A METHOD OF DRAINAGE OF THE ANKLE JOINT.¹

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SOME years ago a number of cases came under my care which varied in detail but had in common this, that they were in effect open injuries of the ankle, that the joint was much soiled by the introduction of foreign matter at the time of the original injury, that disinfection of it was practically impossible, and drainage a necessary feature of the scheme of treatment.

The results of the plans at first used were unsatisfactory to a degree. The drainage was very defective and a pan-arthritis usually developed, which was almost always followed by a spreading cellulitis of the leg and a general sepsis so severe that amputation through the leg had to be made, or, if this was escaped, a rigid and tender ankle only was obtained.

A more effective plan of drainage had therefore to be devised for use in subsequent cases of a similar kind.

On studying the anatomy of the ankle joint from this view point one is quickly struck by the fact that it consists not of a single compartment lined by synovial membrane but rather of two, one anterior the other posterior, separated from one another by the astragalus and the two malleoli (see Figs. 1 and 2), and in communication so far as the flow of synovia or exudate is concerned only by the narrow channels beneath the internal lateral ligament on the inside and the external lateral ligament on the outside, which channels in the presence of any swelling of the synovial membrane must be almost if not quite blocked and impermeable, but which through the continuity of

¹ Read before the New York Surgical Society, May 9, 1906.

the lining synovial membrane make extensions of inflammations from one sac to the other possible and easy. (Fig. 3.)

Furthermore the tendons in relation with the anterior and posterior ligaments compress the synovial membrane against the underlying bone and increase the difficulties to be overcome by preventing the introduction of drains of sufficient size for the purposes in view.

The plan of drainage in the earlier cases consisted essentially in the introduction of drains through the site of injury and also through counter openings made into the joint at points at which the synovial sac could be tapped most readily, and, as has been said, with most unsatisfactory results.

It seemed necessary in order to drain the joint with anything like sufficiency that space would have to be provided that would allow access to both sacs to clean them, in which to place suitable drains and through which exudate could be discharged. These conditions can best be complied with by the removal of the astragalus; for with this bone out of the way both sacs become easily accessible and there is ample room for the drains themselves and for counter openings.

Finally, the resultant state is certainly as good if not better than where, even if the leg is saved, a stiff and tender ankle is obtained.

The plan adopted, then, in several more recent cases consisted in excision of the astragalus and the drainage of the ankle through the space so created.

The method to be used in establishing this condition varies naturally with the character of the original injury.

The astragalus itself is most accessible through an incision over its head parallel to and to the outer side of the extensor tendons made with the foot strongly adducted. Through this the neck is seized by heavy forceps and drawn upon while the attached ligaments are divided and the bone freed and removed. Counter openings can now be made behind on either side of the tendo Achillis and drainage tubes placed in them. After thoroughly cleansing the joint cavity

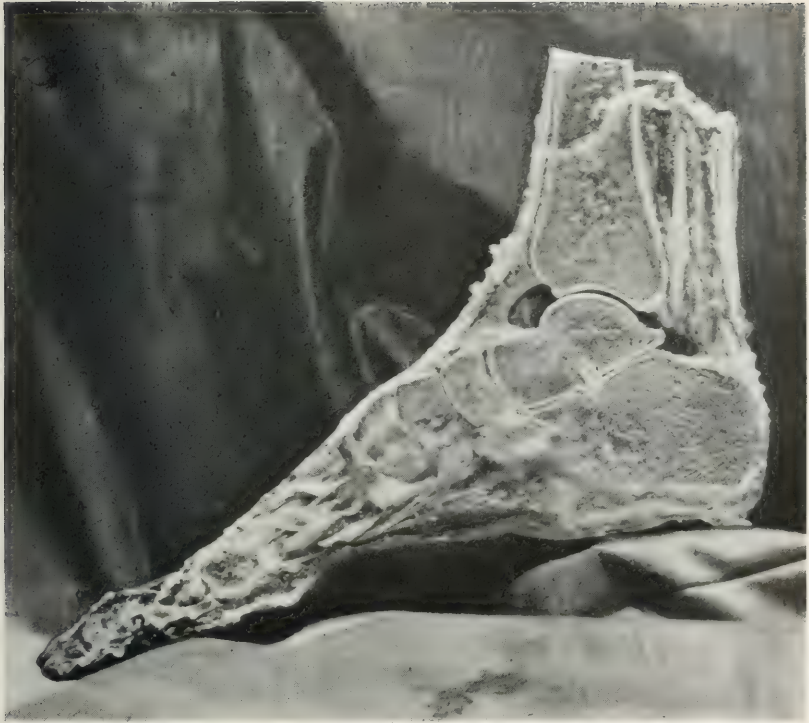


FIG. 1.—Longitudinal section showing anterior and posterior synovial sacs.



FIG. 2.—Horizontal section showing anterior and posterior sacs.

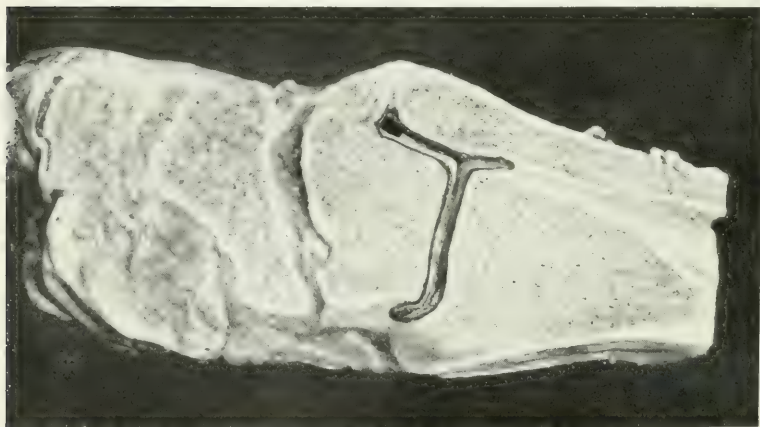


FIG. 3.—Frontal section showing, when the bones are in apposition, the slight communication between anterior and posterior sacs.

and taking care of the bone injuries the space is packed with gauze through the anterior opening and the latter kept open by the end of the gauze packing.

The foot is then brought into proper position and enveloped along with the leg in a bulky dressing and placed in a gutter splint.

The first dressing is made about the fourth or fifth day, not sooner, unless special reasons develop, and subsequent dressings at intervals of about three days.

The final result shows an ankle in which there is slight motion, the foot at right angles to the leg and the distance from the knee to the under surface of the heel shortened about $\frac{3}{8}$ to $\frac{1}{2}$ inch.

Since adopting this method I have not seen a cellulitis of the leg develop and I have not been compelled to amputate in a single instance.

Although my experience has been confined to traumatic cases and among these to serve compound Pott's fractures, compound fractures and displacements of the astragalus and unclassifiable crushes of the ankle, I am inclined to believe that the same method would be of great service in certain suppurations of the ankle where thorough drainage is desirable.

As illustrations the following outlines of two typical cases may be of interest:

CASE I.—Female, aged twenty-two. Admitted to hospital after having been run over by a street car. On examination there was a traumatic amputation of the right leg at the knee for which a Carden's amputation of the thigh was done.

At the left ankle there was a severe Pott's fracture with a good deal of contusion of the soft parts about the external malleolus, comminution of the lower end of the tibia and compounded by a large wound over the inner malleolus.

For this the astragalus was removed, the joint thoroughly washed out and the space packed with gauze from in front and also drained by a tube emerging behind between the external malleolus and the tendo Achillis.

There was much sloughing of the tissues of the outer ankle, including the peroneal tendons, but no cellulitis at all. The wounds gradually closed and the ankle ankylosed in good position.

She is now free from pain, walks with a cane and has "slight motion" at the ankle.

CASE II.—Male, aged twenty-three. Admitted to hospital after elevator accident. On examination there was a fracture and dislocation of the right astragalus compounded through a lacerated wound over the head of the bone.

An attempt was made to save the joint but an arthritis soon began which made it necessary to remove the astragalus through the original wound. The space was thoroughly washed out and packed with gauze from in front and further drained by tube through counter opening behind.

Convalescence was rapid and without incident.

Some weeks later the patient was walking easily upon the extremity, the foot was in good position and there was slight motion at the ankle.

SARCOMA AND MYOMA OF THE STOMACH.¹

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SARCOMA of the stomach is of such rare occurrence that it has received little serious consideration from clinicians and but passing notice from pathologists. The increasing frequency with which such lesions are being recorded in medical literature may indicate that many similar tumors have hitherto escaped recognition through a natural tendency to regard all gastric neoplasms as carcinomatous, or it may be merely the result of the growing interest in such affections due to the more recent and wider spread tendency towards their radical treatment.

A myoma is here included not on account of its even greater rarity than sarcoma but because clinically it may simulate exactly a fibrosarcoma and pathologically it is capable of sarcomatous degeneration.

The following three cases which occurred within nine months in Dr. Ochsner's clinic will illustrate the early development of a myoma as well as the two main clinico-pathological groups into which primary gastric sarcoma may be divided, the one clinically indistinguishable from carcinoma, the other relatively benign and at times capable of preoperative recognition.

CASE I.—Mr. C. C. (16518), aged 73. The family and past history were unimportant. The present illness began ten years previously with distress in the epigastrium and right hypochondrium, usually associated with eating, was fairly constant with occasional slight exacerbations. Only within the last few months had there been attacks of colic. These had not been more than moderately severe and quite characteristically of gall-bladder

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origin and were followed by temporary though slight jaundice. Neither hæmatemesis nor melæna had occurred.

Physical examination aside from a rather marked anæmia and emaciation revealed nothing of importance beyond a decided tenderness in the mid-epigastrium and over the region of the gall-bladder. The patient was sallow but not jaundiced. The gastric symptoms had been so much more intense than usually seen with cholelithiasis that, taken together with the patient's condition and age, a carcinoma or ulcer of the stomach was suspected in addition to the gall-stones, in spite of the absence of dilatation, palpable tumor and signs of obstruction. The physical and mental conditions were such that it was deemed unwise even to make a blood-count.

Operation by Dr. Ochsner June 29, 1905.—The abdomen was opened by a high right-rectus incision. As soon as it was certain that there was no danger of spreading infection from the biliary tract the stomach was examined and at first thought to be normal though a nodule, at first supposed to be enlarged retro-peritoneal gland, was palpable upon the spine behind it. The mobility of this mass suggested its inspection through a rent made in the greater omentum. This was readily accomplished and a walnut-sized slightly nodular pedunculated tumor was found growing from the everted posterior wall of the stomach near the greater curvature. Gentle traction upon the tumor pulled out a cone of stomach-wall which was clamped transversely. A purse-string silk suture was placed about the base of the cone proximal to the clamp, the distal apical portion containing the tumor was removed and the stump then inverted precisely as in an appendectomy with a continuous Cushing stitch reinforcing the purse-string.

After breaking up adhesions of the omentum, duodenum, and hepatic flexure of the colon to the gall-bladder, nine moderately large stones were removed from it and the cystic duct. The common and hepatic ducts were free. Cholecystotomy completed the operation.

The patient made a slow but complete recovery; the biliary fistula closed spontaneously. His general health steadily improved and he is now actively engaged in literary and clerical work, taking care of house and garden by way of recreation.

In a letter written May 18, 1906, nearly eleven months after operation, he says: "Barring the customary infirmities of age, I do not see but I am as well as I ever was."

Pathological Examination.—Gross: The specimen of a hard elastic nodule ($3 \times 2 \times 1\frac{1}{2}$ cm.), surface round, slightly irregular, and covered by normal looking serosa except at one pole where it is attached to a circular cuff of the entire gastric wall ($1 \times 1\frac{1}{4}$ cm.).

On section the tumor was made up of interlacing bundles of fibrous-looking tissue, one of which about 3 mm. wide extends around superficially beneath the serous coat but becomes indistinct at the gastric attachment.

The tumor apparently originated to the outer side of the submucosa which together with the mucosa is intact and normal in appearance.

Microscopic.—The mucosa and submucosa were in no way found to be abnormal. The tumor was made up of masses of large spindle-cells with a tendency to arrange themselves into bundles. There was no great variation in the size of the cells, the nuclei were large, centrally placed, without mitoses, and showing similar straining reactions.

VanGieson's stain confirmed the diagnosis of the myomatous nature of this tissue. Fibrous tissue was present in small amounts, the blood-vessels were few and small. There was not complete encapsulation. At its inner growing aspect the tumor, which seemed to have sprung from the outer muscular coat, was sharply differentiated from the normal muscularis by the greater size and pallor of its cells. Though the growing edge was irregular there was no evidence of any distinct infiltrating tendency. Diagnosis: Myoma.

About forty cases of gastric myomas have been described since the first one recorded by Morgagni in 1762.

They occur more commonly in middle-aged men and grow from any of the muscular coats but are usually found near the greater curvature at the cardiac end of the stomach. Cases have been reported where the pylorus or the duodenum was involved. These tumors are usually single and commonly remain small pea-sized nodules within the thickness of the

stomach-wall but have been described as large as a man's head.

As a rule the growth is slow and the tumor remains symptomless unless ulceration or obstruction is caused or in case of the larger examples where mechanical interference is produced. The submucous variety is supposedly prone to become pedunculated and undergo cystic degeneration, the subserous to be more subject to sarcomatous degeneration.

CASE II.—Mrs. O. R. (14990), aged 37. The family and past history were unimportant. The present trouble began eight months prior to her admission, with a sudden attack of epigastric pain, radiating to the sternum and into the back, followed by a "severe vomiting spell." Shortly after this she noticed a tumor in the left epigastrium, freely movable and at times palpable to the right of the median line. Gastric distress in increasing constancy and severity ensued together with intermittent attacks of pain and vomiting, the last one of which occurred three days before admission to the hospital.

There had been no hæmatemesis nor melæna. Emaciation had been gradual, but continuous and was advanced. At the physical examination a round, hard movable tumor, the size of a fist, was present beneath the left costal margin in the epigastrium. It was not tender and was continuous with the stomach tympany. The examination otherwise aside from a noticeable anæmia was practically negative. The urine was normal, the acid gastric contents after a test meal contained no free hydrochloric acid and no organic acids. No Oppler-Boas bacilli were present. The blood-count showed erythrocytes 4,800,000; leucocytes, 8,500; hæmoglobin, 85 per cent.

Operation by Dr. Ochsner, Sept. 9, 1904.—The stomach was exposed through high right-rectus incision. A growth was found near the pylorus involving the greater curvature and posterior wall of the stomach but had apparently not extended beyond the immediately adjacent omental lymph-glands.

An incomplete gastrectomy was done, including the pylorus and the fundus beyond the Cuneo-Mayo line. The adjacent portion of the corresponding omentum was also removed. The cone of the stomach remaining at the cardiac end had such a narrow base

that it was possible to make a direct end to lateral implantation into a suitable loop of jejunum brought up anterior to the transverse colon and taken just enough distal to the duodenum to prevent traction upon the anastomosis, which was effected with two rows of continuous silk sutures. Owing to accidental infection, drainage was used.

The patient recovered fairly well from the operation and improved steadily for two weeks, when in spite of a fairly good appetite and freedom from distress she gradually lost strength and died on the twenty-seventh day.

A limited post-mortem examination of the abdomen was permitted. A few fine adhesions marked the drain tract; the anastomosis was perfect, the silk having been covered by the serosa, which was apparently continuous from the stomach on to the intestine. As far as could be determined the abdominal cavity was otherwise normal.

Pathological Examination.—Gross: The tissues removed at operation showed that the main involvement was along the posterior aspect of the greater curvature. This consisted of a mass $7\frac{1}{2} \times 10\frac{1}{2} \times 5\frac{1}{2}$ cm. in size which protruded 3 cm. into the lumen of the stomach. It was situated 3 cm. from the pylorus, which was not directly involved but had probably been obstructed to some extent by the intra-gastric projection of the tumor. Two smaller nodules $2 \times 2 \times \frac{1}{2}$ cm. and $4 \times 4 \times \frac{3}{4}$ cm. were present on the posterior wall near the large growth and to its proximal side.

The mucosa away from these tumors was fairly normal in appearance, extending well up on the sides of the growths but probably not intact over their convex surfaces, though any ulceration was slight and there was no tendency to any fungous growth. Several enlarged glands were present in the attached omentum.

On section the tumors presented a bulging, grayish, semi-translucent, homogeneous surface. The margins of the mucosa were sharp and there was no tendency to atypical epithelial down-growth. Where the muscularis was being invaded the margins of the tumor were usually well-defined and rounded, with little macroscopic evidence of infiltration. The enlarged lymph-glands had a similar appearance, so that metastatic involvement seemed probable.

Apparently the growth began on the inner side of the submucosa and only penetrated this layer when the tumor had attained sufficient size to offer a greater counter resistance. In the most advanced portions of the large mass the growth had reached the serosa; in the less advanced it had remained distinctly within the level of the submucosa. Where the tumor had reached the serosa, whitish miliary nodules were scattered upon the surface.

Microscopically the large tumor was composed of dense, irregularly-placed masses of large round or polyhedral cells, varying from three to ten times the size of an erythrocyte. The nuclei were large vesicular, varying in size with that of the cell, and were centrally placed in a relatively small amount of pale granular cytoplasm. Few mitotic figures were present, giant forms with three to five nuclei were frequent, and metachromatophilia was marked. Numerous small round cells, very many eosinophiles and a few polymorphonuclear leucocytes occurred. The delicate stroma was slight in amount and the relatively few blood-vessels were well preserved. No thrombi of tumor cells were present, though suspicious individual intravascular forms were not uncommon.

Sections from the smaller nodules had a similar appearance, the individual cells were more alike in size and staining reactions, mitotic figures more frequent, but the giant forms and the eosinophiles were distinctly less numerous. There was relatively more stroma and fewer blood-vessels.

The mucosa away from the tumor was not strikingly abnormal, the epithelial cells were pale and granular and many chalice forms were present. No parietal cells were seen. Nearer the tumor mucosa cells with very marked eosinophilic granulations were numerous. The villous stroma was largely composed of plasma-like cells and eosinophiles. Pressure atrophy had caused a disappearance of the mucosa structures and where the growth had extended to the gastric lumen there was a slight fibrino-cellular exudate resting on a narrow more or less distinct connective-tissue base. The advancing edge of the tumor was clearly marked, the compact mass of large pale cells was sharply differentiated from the more normal structures, and in places there was a definite boundary zone between the two made up

of small round cells and many eosinophiles. There were evidences of recent remote hæmorrhages into the mucosa and submucosa.

The submucosa was the most resistant of all the layers to the destructive action of the growth, and once penetrated, persisted longer within the tumor tissue than any other normal structure. It was apparently not penetrated until pushed outward by the tumor and consequently diminished in thickness. In the smaller masses (it was evident that the growth began to the inner side of the submucosa, possibly to the lumen side of the muscularis mucosæ. Where the muscularis had not been involved by the tumor it was normal, perhaps slightly hypertrophied. The serosa was for the most part intact; where the growth had extended up to it, there were occasional perforations with a localized exudate composed of tumor cells, erythrocytes, leucocytes, and fibrin.

Sections from the enlarged lymph-glands in the omentum showed only the chronic inflammatory changes so common with gastric ulcer. No metastases were encountered. Diagnosis: Large, round-cell sarcoma.

CASE III.—Mr. C. L. S. (15367), aged 44. Family history unimportant. He had always been well up to the present illness, which began ten months previously, but was an habitual user of stimulants. Immediately following alcoholic excesses, he was suddenly seized with nausea and epigastric pain followed by hæmatemesis so profuse as to cause syncope. Recovery from this attack was protracted but apparently complete and there had been but one subsequent and much less profuse vomiting of blood. Melæna was noticed at irregular intervals up to the time of admission. Four months after the onset he first noticed a tumor beneath the left costal margin. This had not increased materially in size and except from purely mechanical action had been productive of no untoward subjective symptoms. The general health was excellent and he had remarked no loss in weight nor strength.

Physical examination revealed no advanced cardio-vascular change. The liver was normal in size and there was no evidence of obstruction to the portal circulation. A considerable degree of anæmia without icterus was noticed. In the upper left quadrant of the abdomen was a round solid tumor, about the size

of a child's head, not tender, freely movable and with no palpable notches nor nodules. It descended with inspiration and on standing sank beneath the level of the umbilicus. When lying on his right side, the tumor extended to that side of the median line; when on his left side, it fell back beneath the costal margin. The mass was flat on percussion and its relationship to the stomach tympany was not established. The blood-count revealed an unexpectedly severe anæmia, leucocytes 13,000, erythrocytes 4,000,000, hæmoglobin 43 per cent. There was no abnormality found in the differential count and no adventitious elements were encountered. The urine was normal. Through an error, the examination of a test meal was omitted.

Operation by Dr. Ochsner, Nov. 23, 1904.—The abdomen was opened by a left rectus incision exposing immediately the large smooth-walled semifluctuant tumor which arose by a small pedicle from the posterior wall of the fundus of the stomach, near the greater curvature. The aspect of the intra-gastric portion of the tumor was dome-like and encroached very slightly upon the ventricular cavity. The surrounding stomach-walls were healthy and the viscus was but little if any dilated.

The growth had become adherent to the posterior parietes and to the omentum, and as soon as these adhesions were freed the excision of its gastric attachment was rapidly effected. An incision was made into the stomach 3 cm. from the pedicle and the corresponding margin of the proximal wall immediately clamped; thus was bleeding avoided, and by lifting gently on the forceps the escape of gastric contents was prevented. Consecutive similar steps removed the tumor with surrounding cuff of normal stomach. The resulting gastric wound was closed linearly by two layers of continuous sutures; the first, of catgut, embraced all the layers; the second, of silk, excluded the mucosa. No drainage was employed.

The patient had a rapid and uneventful convalescence and left the hospital three weeks after operation in splendid condition. At an examination made at the hospital, April 10, 1905, four and one-half months after operation, the patient was found to be in almost ideal condition. He had gained in weight and strength, and except for one attack of gastric distress, following a

dietary indiscretion, had been in perfect health. There had been neither vomiting nor melæna. The abdomen was free from tenderness, the scar pale, and the rectus muscle functioned naturally. The stomach was apparently normal in size and position. No free intraperitoneal fluid could be recognized. The patient stated that he had never felt so well at any time. Blood, erythrocytes, 5,280,000; leucocytes, 12,000; hæmoglobin 88 per cent. A test meal, consisting of 60 grams of crackers and 400 c.c. of weak tea, was given after a stomach washing. One hour later the gastric contents were removed and 100 c.c. obtained. Free hydrochloric acid was present in (60) excess of the combined (40). There was a faint trace of lactic acid. Microscopically no blood nor Oppler-Boas bacilli were found. The patient was again examined May 26, '06, 17 months after operation and found to be in excellent general condition, without evidence of any recurrence.

Pathological Examination.—Gross: The tumor was irregularly spheroidal in shape, $16\frac{1}{2} \times 12 \times 8$ cm. in size. Upon its upper surface there was a convex area of gastric mucosa 7×9 cm. connected with a mass by a constriction representing the gastric muscularis. In the middle of this mucous membrane was an ulcer one-half cm. in diameter and three-quarter cm. deep; the base was firm and evidently formed by the growth itself. Surrounding this ulcer concentrically was the pedicle 5.5×4.5 cm., composed of solid tumor tissue. External to this was a cuff of normal stomach-wall. The gastric serosa was continuous upon and completely covered the tumor, except where there had been adhesions or where destroyed by traumatism. The mass was deep bluish in color and the large superficial vessels were considerably distended. The general consistency was subfluctuant and on the anterior surface were superficial cysts closely related to each other, the largest, $3 \times 3 \times 4$ cm.

On section the tumor was found to be made up of soft, gelatinous sago-like tissue, with irregularly-disposed interstitial hæmorrhages. There was both central and subcapsular cystic degeneration, in which a myxomatous metamorphosis was evidently an intermediate step. The resulting irregular cystic cavities were trabeculated and smooth-walled. A definite fibrous tissue capsule extended exerywhere beneath the serosa, and was seemingly complete.

The section through the intragastric portion indicated that the tumor had originated externally to the submucous layer, as that membrane could be readily traced up over the sides of the convex portion, and with the mucosa appeared up to the margin of the ulcer. Here the submucosa ended abruptly and the edges of the mucosa were infolded and thickened. The muscular coats had been almost completely destroyed over an area corresponding to the gastric attachments of the tumor and were distinctly hypertrophic at their marginal termination.

Microscopical.—The tumor was made up of masses of cells and stroma which varied in their relative proportions in different areas. There was also great variation in the maturity of the cellular elements. In some places more normal fibrous tissue was reproduced; in others, the cells were largely of the epithelioid type, though never without coëxisting evidence of their fibroblastic nature. The few blood-vessels were well preserved, though recent and remote interstitial hæmorrhages had occurred. In certain places large connective-tissue trabeculæ were common. A definite, dense, fibrous capsule was present beneath the normal-looking serosa. Except at the base of the ulcer the submucosa was intact and as a rule a small proportion of the inner muscular coat remained attached to it. The mucosa apart from the ulcer was practically normal, parietal cells were well-defined and numerous. At the edges of the ulcer the mucosa dipped down and around the margins of the submucosa. Here the plasma cells were much more numerous and there was a less though still distinct increase in the number of eosinophiles. Beneath the base of the ulcer a tumor nodule had grown between the inner muscular coat and the submucosa. To the pressure and consequent anæmia produced by this nodule, the destruction of the submucosa was attributed, and the ulceration of the mucosa was an indirect result. The base of the ulcer extended to remains of the inner muscular layer and the tumor-tissue. It was lined by a limited superficial fibrino-cellular exudate, which rested upon a thin layer of connective tissue. Diagnosis: Spindle-celled sarcoma.

CASES IV and V.—*Sarcoma of the Stomach.*

These two patients, aged 41 and 30 respectively, complained of pain in the right upper half of the abdomen, with distress

after eating, and occasionally vomiting. The family history in both instances was unimportant. The personal history was negative. The first patient's illness began about eight years ago, with an attack of pain lasting about six weeks. The attacks have recurred since that time about twice a year, each attack lasting about three weeks. They were of sufficient severity to confine the patient to bed. In the intervals he felt perfectly well. Medical treatment proving futile, operation was advised, and the stomach was removed. On microscopic examination, the tumor was found to be a spindle-cell sarcoma.

The second patient became ill about two years ago. One month after the onset of his illness an exploratory laparotomy was performed, ostensibly to relieve a loose right kidney. Nothing was found, however, and after the operation the attacks of pain recurred with equal severity. On palpation, a hard, irregular mass was found in the right side of the abdomen, extending from two inches above Poupart's ligament to about the level of the umbilicus. The tumor was removed.

The following summary of the more recent literature on gastric sarcoma is substituted for a discussion limited to these cases. No attempt has been made to preserve individual references, and a list of those articles from which the data has been obtained is appended. Even less than the usual scant reliance should be placed in the statistical figures, as they varied greatly in different articles dealing mainly with identical cases, and were largely indices of the personal equation of the writers.

Frequency.—It should be recognized that the incorrect diagnosis of carcinoma has been made not only clinically but pathologically, so that any statistics must represent the lower rather than the higher limits of variation. In comparable series embracing about 800 cases of gastric neoplasm, sarcoma was demonstrated in a little less than 2 per cent. W. S. Fenwick assumes that were all cases recognized, sarcoma would be found to comprise 5-8 per cent. of the malignant stomach tumors. This is perhaps partially substantiated by the fact that where Schiessinger, in 1897, was able to collect but thirty-five cases since the first one reported by Sibley in 1816, there are double that number available at the present time.

Age and Sex.—The sexes are about equally affected. The time of onset varies from 3.5 to 78 years; mean age, 34. The average for lymphosarcoma, which is most common from 20 to 35, is 29, and for the spindle-celled, is 51. Twice as many cases begin in the fifth as in any other decade. Primary sarcoma is more common in the young than is carcinoma.

Etiology.—No exciting causal factor is established. Pre-existing chronic gastritis is common, and one case is deemed to have followed a gunshot wound. No suggestion is made that the growth was associated with gastric ulcer. Unlike carcinoma, there is no predilection for areas of constant irritation, so that sarcoma is far less frequent at the orifices.

Pathology.—The stomach is involved in 33 per cent. of the sarcomata in the gastro-intestinal canal. The disease may be primary, or more rarely metastatic, except the lymphosarcoma, which alone exceed the carcinomata in the frequency of secondary invasion. Two types are the most frequent. The round-celled, including the lymphosarcoma, and the spindle-celled, including the myo- and fibrosarcoma. Myxo-, melano- (secondary), angio- and alveolar forms have been described. The growths have three main types: (1) infiltrating; (2) nodular and extending into the stomach; (3) nodular and extending into the peritoneal cavity, though transitional forms occur.

The following practical classification, slightly modified from Alessandri's, is sufficiently complete to serve as a working basis:

Infiltrating tumors.—Lymphosarcoma (great majority); round-cell sarcoma (large majority).

Circumscribed tumors.—Round-cells (few), lympho (rare, usually secondary). All spindle-cell forms, usually pedunculated.

Lymphosarcoma (15-35 per cent).—They originate as a rule on the inner side of the submucosa, but may begin even in the subserosa. A diffuse nodular thickening of the gastric walls is generally produced and the consequent destruction of, or interference with, the muscularis causes motor disturbances.

often dilatation, rarely contraction of the stomach. Hour-glass deformity has been described. Extension to the duodenum and œsophagus is not infrequent. When the pyloric portion of the stomach is thus involved, insufficiency of, rather than obstruction to, that outlet is produced. These cases show remarkably little tendency to ulceration.

Circumscribed lymphosarcomata are exceedingly rare and have been regarded as metastatic. They commonly arise beneath the mucosa as one or more nodules which protrude into the stomach but notably free from superficial ulceration.

Round-cell Sarcoma (28-45 per cent.).—This class is similar to the lymphosarcoma in pathological behavior, particularly the diffuse forms, so that differentiation is usually difficult and frequently impossible. The circumscribed variety occur in a few (6 per cent. of these tumors, and usually begin near the pylorus and project into the stomach cavity. Ulceration is, as a rule, late, and fungous growths rare.

Spindle-cell (including fibro- and the still less common myo-) *sarcoma* (32-36 per cent.).—The point of origin is outward from the submucosa, and usually located on the posterior wall near the greater curvature. The growth protrudes into the peritoneal cavity or between the layers of the omentum, the lesser omentum, or the gastrocolic ligament. These tumors may grow to enormous size. A myosarcoma and a fibrosarcoma, each weighing 12 pounds, are recorded. The mechanical action of such growths may produce gastropsis, gastrectasia, and interfere with the normal functions of other viscera.

Location.—In this regard the variation from carcinoma is marked. The cardiac end is more or less involved in 6 per cent., the fundus in 58 per cent. and the pylorus in 36 per cent. (carcinoma 60 per cent.) with but 9 per cent. of these producing pyloric obstruction. About one-third are more or less diffuse. The greater curvature is more often involved than the lesser, the posterior wall about ten times as frequently as the anterior. The point of origin of the round-cell type has been frequently described as in the sub-

mucosa. The inner muscular layer has been designated as the boundary zone between the points of origin of the two main groups.

Retrograde Changes.—Owing to the large size attained by these tumors, degenerative changes are frequent. Hyaline, myxomatous, cystic and calcareous types have been described. The Fenwicks state that perforation of the stomach occurs in 10 per cent. of the round-cell and lymphosarcoma cases. Interstitial abscess not connected with the gastric lumen may rupture into the peritoneal cavity and cause a fatal peritonitis. It is remarkable how constantly it has been noted that there is so slight a tendency to ulceration and when this does occur it is superficial and as a rule not productive of serious results.

Adhesions.—The occurrence of adhesions to adjacent structures is very infrequent except in the cases of large extrinsic tumors. Even these are usually not firm consequently the motility of the mass is little restricted by them. Adhesions to and rupture into the colon with the production of fecal vomiting have been described.

Metastasis.—As in carcinoma, these tumors are prone to spread through the lymphatics. Remote secondary growths occur in various places somewhat similarly to cancer. About 70 per cent. of the round-cell and lymphosarcoma cases show metastases; the nearby glands are always enlarged and in 50 per cent. contain secondary growths. The nearest glands may be skipped and a more remote group involved. The kidney, liver, omentum, pancreas, ovaries, skin, lungs, pleura, intestines, œsophagus and mediastinal glands are involved in about this order of frequency. The spindle-cell forms less often have metastases, perhaps less than 50 per cent. As in the round-cell types, the perigastric glands are most commonly but less often (37 per cent.) involved. Remote growths occur in the same organs, but with correspondingly less frequency than in the other class of sarcomata.

In general it may be stated that metastases occur later and grow more slowly than in the carcinomata.

Clinical History.—It is repeatedly stated that there is no

distinction from the usual course of carcinoma. In the round-cell and lympho varieties this is true with the exception that there is no preëxisting ulcer history which is so common in carcinoma cases, though long-standing chronic indigestion is frequent. The onset is as a rule insidious, may even be symptomless. The nature and severity of the gastric distress vary with the location and form of the involvement of the stomach (infrequent obstructions, motor insufficiency, etc.). Pain is the most common symptom (76 per cent.) and may be associated with ulceration. Hæmatemesis, melæna, occur as in carcinoma; vomiting is much less common. A slowly-growing tumor is palpable in 30-40 per cent. of these cases, and is prone to appear early. Anæmia is very constant, appears early, progresses gradually, and frequently becomes extreme. The chemistry of the gastric contents is the same as in carcinoma and there is said to be no digestive leucocytosis. The recurrence of enlargement of the spleen and lingual follicles, sarcomatosis of the lymph-glands and skin, and the presence of albuminuria (which is stated to result from renal metastasis in one-sixth of the cases) have been described among the characteristic symptoms but are too uncommon or occur too late to be of any practical therapeutic value.

The conditions in the spindle-cell variety, though mainly similar to those just described, have in addition certain features that are most suggestive.

Hæmatemesis is present in 50 per cent. of these cases and may mark the onset. A palpable tumor is practically constant, freely movable and always in relation with the stomach tympany and usually causing little more than mechanical embarrassment. Anorexia and emaciation and any chronic gastric distress may be absent.

Diagnosis—It is conceivable that under certain conditions the diagnosis of the round-cell varieties might be justified, but practically it is never established without the microscopical examination of tissue recovered from the vomitus or stomach washings. Even at operation the recognition is dif-

ficult as the medullary, scirrhus and colloid types of carcinoma might give similar external appearances.

On the other hand, the spindle-cell forms should be less commonly mistaken when the clinico-pathological conditions are understood, though the differentiation from tumors of the spleen and kidney, cysts of the pancreas, ovary, and kidney, and movable kidney, has been proven by experience to be difficult.

However, the exact diagnosis is far less consequential to the patient than the prompt recognition of a condition demanding efficient aggressive surgical treatment, and this is possible in the great majority of the cases.

Prognosis.—Without surgical intervention, first practiced by Billroth in 1888, the outlook for ultimate recovery is invariably hopeless. The average duration without operation is 15–18 months for the round-cell and 24–32 months for the spindle-cell forms, both distinctly longer than carcinoma.

Theoretically the operative treatment promises better results than in carcinoma, as the tumor is of slower growth, far less apt to become adherent, metastases occur later and are prone to slower growth. Practically this is well borne out in operative results. Corner and Bairbank have collected fifteen cases in which excision was practiced with 20 per cent. immediate mortality; four cases (27 per cent.) were well four, five, twelve and twenty-four months after operation. The average duration previous to the operation has been ten months. Cantwell's cases of excision of a twelve pound spindle-cell tumor with great relief to the patient for eight months upholds the belief that even the advanced cases should be explored and treated radically if conditions are not contraindicated.

Conclusions.—Sarcoma of the stomach, though an uncommon affection, is less rare than has been supposed. The diagnosis of the round-cell varieties is practically impossible, though its existence under certain conditions might be suspected. Those of the spindle-cell type should be frequently recognized and often suspected. In either case the early

recognition of a purely surgical condition is in the majority of instances easy. Since prompt radical treatment offers not alone the best but also the only hope of permanent relief, without a forbidding immediate mortality (which should now not exceed 10 per cent.), procrastination here, as in all cases of suspected malignant disease, is in keeping neither with science nor humanity.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, May 9, 1906.

The President, DR. GEORGE WOOLSEY, in the Chair.

PERINEAL PROSTATECTOMY.

DR. CHARLES H. PECK presented a man, sixty-three years of age, who was admitted to Roosevelt Hospital, in the service of Dr. Brewer, April 11, 1906, giving the following history: He had an attack of gonorrhoea at nineteen years of age; no history of syphilis. Was a heavy beer drinker for many years, but drinks nothing now. In 1877 he first noticed an obstruction to ejaculation during coitus, with momentary pain in head of penis, followed by a dull ache referred to perineum. This condition gradually increased in severity for a year or two, when difficulty in urination was first noticed; the stream was started with difficulty, was small, and caused a burning pain along entire urethra; after drinking large quantities of beer these symptoms became greatly aggravated; the burning sensation would become intense, and there would be bearing down pains in the groins, the pain radiating down into the testicles. For many years the patient had these symptoms, varying in intensity according to his general health, and also according to the amount of beer he drank. About three years ago he began to get up at night to urinate; at first, only once, later two or three times. About six years ago he had an attack of retention of urine, which lasted only a short time, and

was relieved by morphine, without catheterization. Last December, after drinking some beer, another attack of retention occurred, and for two days the urine had to be drawn by a physician, after which time voluntary urination again became possible. Since that time he has had no absolute retention, but he has had to get up more frequently at night; five or six times, and pain on urination has increased, radiating from the groin down into the testicles. His general health is good, and he has no other symptoms.

Examination.—Rectal examination shows a high implantation of the prostate, with both lateral and vertical enlargement. Cystoscopic examination shows intravesicular enlargements of the middle lobe; muscular walls in good condition; bladder capacity good; no residual urine. Urine showed a trace of albumen; no casts.

Operation April 16, 1906. Ether anæsthesia. Lithotomy position, with hips elevated. Median perineal incision; urethra opened on a grooved guide; prostatic urethra dilated with dressing forceps and Young's prostatic retractor inserted into the bladder. Rectum separated from prostate by blunt dissection with finger as high as superior border, with finger of left hand in rectum as a guide. An incision made with scalpel through capsule of left lateral lobe; ungloved finger inserted beneath capsule, and a large globular mass carefully enucleated and removed without injuring prostatic urethra. The process was then repeated through a separate incision over right lateral lobe, and a similar mass, somewhat smaller, was enucleated, using the ungloved finger of left hand for this side, while the right hand manipulated the retractor. By tilting the retractor, a small middle lobe was then enucleated through the cavity left by removal of the right lateral lobe. Especial care was taken in enucleating the upper surfaces, adjacent to the base of the bladder, and the inner borders adjacent to prostatic urethra. The bladder-wall was not damaged, nor, as far as could be determined, was the prostatic urethra injured to any extent.

The time from incision to the complete enucleation of all lobes was fourteen minutes; six minutes more were occupied in passing a No. 33 F. sound through the urethra into the bladder, searching for a possible stone through the perineal wound, irri-

gating the bladder, fastening the perineal drainage tube in place, and closing the wound, making a total of twenty minutes for the operation.

Hæmorrhage was very moderate; no vessels were clamped or ligated, a strip of gauze packing on either side of tube sufficing. There was no evidence of shock.

There was very little reaction, the highest temperature being 101, on the fourth day. Tube drained well; it was removed on the sixth day. A No. 29 F. sound was passed to the bladder on the eighth day, and again on the twelfth day.

The patient was allowed out of bed on the ninth day. By the tenth day, partial urinary control was established, urine passing both by urethra and perineal wound at each act, but not escaping between times. The interval between acts of urination rapidly lengthened, and on the sixteenth day he went from 7 P.M. until 5 A.M. without urinating or wetting the dressing.

On the eighteenth day, urine had ceased to come by the perineal wound, all passing by the urethra.

DR. GEORGE WOOLSEY said that while Dr. Peck's case was an example of the easy type of perineal prostatectomy some of them were very difficult. The speaker said he was struck by the paper of Dr. Young, of Baltimore, showing the frequency with which he had met with malignant conditions of the prostate. Personally, he had seen but one such case, and in that instance the malignant process was very distinct. The median perineal incision, which Dr. Peck had employed in his case, gave an excellent exposure of the prostate, and the speaker said he had resorted to it last summer, with good results, in dealing with a case of fistula between the rectum and urinary tract. One objectionable feature to an extensive perineal incision was the long period of convalescence it entailed.

DR. PECK, in reply to a question, said there was no history of residual urine in his case. In view of the size of the prostate, this was rather surprising, but it was probably explained by the fact that the greater portion of the hypertrophy was in the lateral lobes. The absence of residual urine accounted for the comparative mildness of the symptoms, in spite of their long duration. In cases of this type, Dr. Peck said, and where there was no suspicion of malignant disease, the short, median perineal incision seemed to be of peculiar advantage.

A METHOD OF DRAINAGE OF THE ANKLE JOINT.

DR. PERCY R. BOLTON read a paper with the above title (for which see page 595).

DR. WOOLSEY said it had always seemed to him that the methods commonly employed in cellulitis about the ankle joint or actually involving the joint gave very unsatisfactory results, and any improvement on those methods should be welcomed. The speaker said he had often noticed how well patients got along without the astragalus, especially after its removal for the correction of club foot. In such cases, of course, the operation was a clean one, but even when the bone was removed in cases where infection had already occurred, the result, according to Dr. Bolton, was very good.

DR. PECK said that while he had no personal experience with the method described by Dr. Bolton, he appreciated how rational it would be in dealing with certain conditions about the ankle joint. He recalled one case within the past year where an amputation was done which might possibly have been avoided had this method been resorted to. The case was a low form of osteomyelitis in the tibia, and proved so intractable that amputation was finally deemed advisable.

DR. JOHN A. HARTWELL said he could corroborate what had been said about the poor results obtained by the older methods. He recalled the case of a woman who, after an abortion, became septic, and finally the ankle joint became infected. The joint was freely opened, and the wound drained both anteriorly and posteriorly, but in spite of this the infection spread upward, and finally amputation through the middle thigh was done as a life-saving measure. The astragalus was not removed.

Dr. Hartwell said he could recall a number of other traumatic cases in which the joint had become infected, and in some of them, in spite of free drainage, amputation was finally necessary. In one case in which the leg was saved, the joint remained so indurated and painful that it was almost as bad as an amputation.

MULTIPLE SEPTIC INFARCTS OF THE RIGHT KIDNEY—
NEPHRECTOMY.

DR. CHARLES H. PECK reported the case of an unmarried woman, thirty-one years old, who was seen in consultation with Dr. R. H. McConnell on April 8, 1906. She had not felt well

for about three months, complaining of headache and malaise, and during this time the urine had persistently shown the presence of albumen and casts, which had, however, diminished in amount under treatment. There had been no localized pain, elevation of temperature nor other symptoms up to Saturday, April 7, when at 9 A.M. she was suddenly taken ill with a chill, soon followed by a severe pain in the right side of the abdomen, and vomiting. When first seen by Dr. McConnell, at 2 P. M., the temperature was normal; pulse 84; there was no tenderness nor rigidity, and the pain had abated somewhat. Later in the day another chill occurred, and the following morning a third, with increased pain. At 7 P.M. on April 8, the temperature was 101, and there was marked tenderness and rigidity in the right flank. At 8 P.M. there was another chill, and at the time of the consultation, 10 P.M., the temperature was 103.6, there was marked tenderness and rigidity, and a distinct feeling of a mass in the right flank in the line of the colon at the level of the umbilicus. No tenderness could be elicited by pressure over the kidney posteriorly. A probable diagnosis of appendicitis, with a high retrocolic appendix, and localized abscess, was made, and operation advised. The following day she was admitted to the French Hospital. Another chill occurred at 4 P.M., followed by a temperature of 104. Leucocytes were 30,400, and polynuclear cells, 92 per cent.

Operation, at 8.30 P.M., about sixty hours after the onset of her acute symptoms. Chloroform and ether anæsthesia.

Appendix exposed through a high right Kammerer incision. It contained a concretion, but showed no evidence whatever of acute inflammation. It was removed, and the stump inverted in the usual way. The liver, gall-bladder, and pyloric region of the stomach appeared normal. The mass felt was easily identified as an enlarged right kidney. The abdominal wound was quickly closed and the patient turned on her side. The right kidney was exposed by an oblique incision; the surrounding fatty capsule was œdematous and somewhat adherent. The kidney was considerably enlarged, and through the capsule proper numerous small, white, elevated points could be seen. On stripping off the capsule, these proved to be minute abscesses, droplets of pus appearing on the cortex. Nephrectomy was deemed the safest procedure, in view of the acute septic symptoms and the mul-

tiple lesions, and the kidney was removed, the ureter and vessels being separately ligated with heavy chromic gut. Two cigarette drains were placed down to the pedicle, and the remainder of the wound closed by layers, with chromic gut, silkworm gut, and silk. Time of both operations fifty minutes; condition fair.

On section, the kidney showed numerous minute abscesses in the cortex, and moderate general enlargement. There was a small calculus in the pelvis, but no pus. Cultures from the abscesses showed a pure growth of the colon bacillus.

On April 11 the leucocytes were 17,240, and the polynuclear cells 89 per cent. On April 12, 12,800 and 85 per cent.; on the 16th, 8,800 and 73 per cent. The temperature and pulse dropped steadily, and since the sixth day after the operation have been practically normal.

The urine, before operation, contained a distinct trace of albumen, with granular and epithelial casts, and pus-cells. Since the operation a faint trace of albumen and a few pus-cells have persisted, but no casts. The quantity secreted by the other kidney has been from twenty-five to forty ounces daily. The abdominal wound healed *per primam*, as did the kidney incision, except for slight suppuration along the drainage tract. Patient was allowed out of bed on the twenty-first day after the operation, and left the hospital on the twenty-seventh day, practically well.

DR. BOLTON said that up to a year or so ago he believed that the condition of septic infarcts of the kidney was an indication for the removal of the organ. About that time he saw a woman at the New York Hospital who had two kidneys of this kind, and it was very interesting to watch the history of the case. She would complain of violent pain in the region of the kidney, a mass would become palpable, and the woman would become markedly septic. Then the symptoms would gradually abate, and the tumor would disappear. Exacerbations of this kind would recur at varying intervals, on one side or the other, until finally, after some months, the attacks ceased, and the patient left the hospital fairly well.

The history of that case, Dr. Bolton said, corresponded with what Dr. Robert F. Weir had told him long ago, that some of these cases of miliary abscesses recovered spontaneously, a fact which he had seen verified at autopsy.

DR. HARTWELL said the blood-counts in the case reported

by Dr. Peck were a good illustration of the point raised by Dr. C. L. Gibson in his paper on the "Value of Differential Leucocyte Count in Acute Surgical Diseases," which was read at a recent meeting of the Society, and published in the *ANNALS OF SURGERY*, April, 1906. In Dr. Peck's case, just prior to the operation, the leucocyte count, practically, was 30,000, with 90 per cent. of polynuclear cells, and this disproportion between the leucocytes and the polynuclears persisted during the patient's recovery, the latter remaining high, indicating, as Dr. Gibson had pointed out, a favorable prognosis. The case emphasized the value of the differential blood-count as a diagnostic and prognostic aid in cases of this character.

DR. JOHN F. ERDMANN suggested that in certain of these cases, conservative treatment by incision and drainage should be given a trial before resorting to nephrectomy. Some three or four years ago he did a nephrotomy for a ruptured hilum, with multiple abscesses, and drained the kidney, but on the fifth day he removed the organ entirely. Eight months later, a large calculus was removed from the opposite kidney. That case, the speaker said, had impressed him with the importance of the greatest conservatism in renal surgery.

DR. WOOLSEY referred to the case of a man who had subacute renal symptoms associated with a palpable right kidney, the lower end of which seemed to be much enlarged, and upon operation it was found to contain numerous cortical abscesses, which were limited to the lower pole of the organ. As the upper section of the kidney was apparently normal, he removed the lower third, and after suturing, allowed the rest of the organ to remain. The patient made an excellent recovery. The case was one of staphylococcus infection.

DR. PECK, in reply to a question, said that the calculus in the case he had reported was a small one, and could not be palpated before the kidney was opened. The patient had given no previous symptoms of stone, and there were no evidences of a pyelitis. In removing the kidney in this case, Dr. Peck said, he had been influenced largely by the fact that, according to the literature on the subject, those cases that were drained did badly, and for that reason a nephrectomy was justifiable. In future, however, he would be inclined to give conservative methods a trial.

TRANSACTIONS

OF THE

CHICAGO SURGICAL SOCIETY.

Stated Meeting, May 4, 1906.

The President, DR. D. A. K. STEELE, in the chair.

THE DIAGNOSTIC VALUE OF POTASSIUM IODID IN SYPHILIS.

DR. EDWARD H. OCHSNER exhibited a patient to illustrate the fact that the statement commonly made in text-books that potassium iodid when given in sufficiently large doses proves or disproves the presence of syphilis is not necessarily correct. He has quite a list of syphilitic patients who had previously received very thorough treatment with potassium iodid without benefit.

The patient exhibited had been referred to him by a practitioner who had treated the patient with potassium iodid and intramuscular injections of bichlorid of mercury on the theory that the patient was syphilitic, but as the progress of the disease did not seem to be retarded in any way, he had begun to doubt his original diagnosis.

The lesion which involved the nose was so typical of tertiary syphilis that there could be practically no doubt as to the diagnosis, consequently the patient was put on fumigation treatment with calomel, and potassium iodid internally, with the result that the lesion rapidly improved and with the exception of slight persisting deformity the patient appears to be cured.

DR. ARTHUR DEAN BEVAN asked whether the fumigation treatment of syphilis is applicable in all cases? His experience has been that in some cases one method is successful while in other cases another method of treatment achieves results. He has also seen cases of advanced syphilis which would clean up very rapidly under four or five grains of potassium iodid daily which were not affected by eighty or ninety grains a day. Then, again,

some of the tertiary forms of the disease clean up more rapidly under the mixed treatment than under either potassium iodid or mercury. He recalled one case of tertiary syphilis in which the lesions would fade away under the iodid, would be benefited somewhat by the protiodid only to reappear rapidly, and again disappear for months after a few hypodermic injections of bichlorid.

DR. L. A. GREENSFELDER suggested that the proper dose of potassium iodid is the one that produces the physiologic effect, no matter what its size. Until that effect appears it is impossible to say that the patient has received a sufficient dose. The intravenous injection of a one or two per cent. solution of the bichlorid directly into a vein, giving one or two c.c. every day for fifteen or twenty days, is quite efficacious in these cases. He used that method in cases that were under the potassium iodid treatment, and also under the intramuscular injection treatment, and in which no effect was produced. After three or four intravenous injections the result was quite prompt. He said that it is essential not to use less than a one per cent. solution, and if that fails to produce any effect, a two per cent. solution should be used.

DR. WM. HESSERT also recommended the intravenous injection method. He now has under his observation a patient who had been treated by all other known methods without result. After about half a dozen injections of three c.c of a one per cent. solution of bichlorid a very satisfactory effect became evident. The lesions on the skin and elsewhere, which had been very marked, disappeared rapidly. He believes that in protracted and obstinate cases of syphilis the intravenous method is one of the most satisfactory methods of treatment.

DR. OCHSNER agreed with Dr. Bevan that a method which fails in one case may succeed in another. He does not believe that the fumigation treatment is a specific for all cases of syphilis but in his experience every case that has resisted the potassium iodid, or even the mixed treatment, has responded to fumigation. He referred to one case that had received as large doses of potassium iodid as she would tolerate for seventeen years without being cured. She was put on the fumigation method and during the last three years there has been no new outbreak of the disease.

The patient is placed in bed, disrobed, a frame is placed over the patient and over this a rubber sheet covered with several blankets. Only the head of the patient is allowed to project. A funnel is introduced under the bed clothes at the lower end of which there is a pan containing one or two drams of calomel. Under this pan a bunsen burner is placed and the fumes of the calomel are distributed over the body of the patient. These hot-air bath fumigations are given every day or every other day, according to the tolerance of the patient.

He could not give an intravenous injection of mercury or any other drug until he had tried all the other and simpler methods of treatment. He thought that intravenous injections were given altogether too frequently just at present and that he would use them only as a last resort.

RENAL TUBERCULOSIS; NEPHRECTOMY.

DR. WILLIAM HESSERT reported the case of a woman; aged thirty-five; single; father died at seventy of kidney trouble; three cousins died of tuberculosis; habits good; menstrual history normal; who during the last weeks of 1905 began to "run down," felt tired, lost weight and appetite, and there was a general feeling of malaise and exhaustion. No other specific symptoms of any kind. Went to a hospital for a "rest cure," and gained slightly, but had profuse night sweats. No pain nor chills. This condition lasted for some weeks, when she noticed that the urine looked purulent. She had no pain nor any other urinary symptoms. She was then seen by Dr. D. E. Murphy, who referred her to Dr. Hessert.

Examination revealed a large mass in the left renal region, the size of a child's head, immovable, not tender, rather firm in consistency, and not fluctuating. Urine loaded with pus. Temperature 101° to 103° .

Blood examination: White blood corpuscles, 13,200; red blood corpuscles, 4,430,000. Hemoglobin, 52 per cent. Polymorphonuclear, 79.5 per cent.; large lymphocytes, 13 per cent.; small lymphocytes, 6.9 per cent.; eosinophiles, .6 per cent.

The ureters were catheterized by Dr. L. E. Schmidt. Urine from right ureter normal. From left ureter there was with difficulty obtained a small amount of fluid for examination, which

proved to be practically pure pus, with no urinary constituents.

Indigo carmine injection into buttocks. After six minutes color was perceptible in urine from right side, while it did not appear after five hours from left catheter.

Cryoscopic examination of blood showed a freezing point of 0.58.

A diagnosis of pyonephrosis was made and the kidney removed in the usual manner by oblique lumbar incision. The kidney measures 8 inches in its largest diameter. Nothing of renal cortex was visible macroscopically. The kidney was converted into a multilocular pus sac. The pus was partly fluid, partly cheesy. At the lower pole was a cheesy area, over one inch in diameter. Microscopic examination proved the process to be of tubercular origin. There were no stones.

The patient made an uneventful recovery and has since regained her health and increased in weight.

DR. BAYARD HOLMES was not sure that tuberculosis appears in a single kidney in a large proportion of cases. He has had several unfortunate experiences, and one quite fortunate one. He operated on a young man in 1896 who had trouble with his back, hæmaturia and strangury, and a diagnosis of tuberculosis of the right kidney was made. An incision was first made over the left kidney and it was examined. Two apparently tubercular foci were found. They were cut out, scraped thoroughly, packed with iodoform gauze and drained through the back. An incision was then made over the right kidney and from it five similar foci were excised, scraped, packed and drained through the back. Since that time the man has had a permanent fistula in the right side, and in the left side a fistula which closes occasionally. He has continued at his occupation, that of a barber, for ten years, and is getting along very nicely.

DR. D. N. EISENDRATH was of opinion that the specimen was typical of a tuberculosis of the kidney. He emphasized the uselessness of drainage in these cases, even in the early stages of the disease. The rational treatment in the majority of these cases is a complete and radical extirpation of the kidney. He also agreed with Dr. Holmes that a large percentage of these cases of kidney tuberculosis are bilateral and not unilateral. Many early cases undoubtedly are unilateral, but in the advanced

cases where the infection has descended to the bladder and ascended the opposite ureter, the disease is bilateral.

In all cases of septic disease of the kidney he has made it a rule not to ligate the stump of the ureter but to cauterize it thoroughly with pure carbolic acid followed by pure alcohol. The best plan, he thought, if there is extensive involvement of the ureter in tuberculosis, is to follow it down to the bladder and extirpate.

He thought that gonorrhœal urethritis and cystitis laid the foundation of a tubercular involvement. He has seen cases beginning as a gonorrhœal epididymitis and cystitis in which later tubercle bacilli appeared in the urine. After the affected kidney was removed the same germs obtained in a pure culture from that organ.

DR. L. L. McARTHUR protested against the use of the ureteral catheter in cases presenting a very infective urine. He thought he had a case under his care which was a possible infection of a well kidney by that procedure. A very competent man examined the ureters with a ureteral catheter finding a stenosis of left ureter negative on right side. Some months afterwards, the diagnosis having become perfectly clear of pyonephrosis the left kidney was removed. The wound healed by first intention, but the urine from the remaining kidney contains pus. The kidney removed was probably tubercular. The patient had some pain on the right side, whereas when the cystoscopic examination was made some months before that kidney was found normal.

Giordano of Venice recently suggested a little procedure which seems to be a valuable one, and that is, while using the cystoscope to note the flow of pus suspected to come from one ureter or another, the assistant compresses firmly, at a given signal, the kidney suspected to be involved and if there is any purulent material in it, it often can be squeezed out, thus making it unnecessary to pass the catheter up that ureter. Both kidneys can be made to empty their pelvis in that way.

CYST-ADENOMA OF JAW.

DR. L. L. McARTHUR presented a man, forty-two years old, who eighteen months previously noticed a tumor in the lower jaw beneath the left first molar tooth. The tumor involved the alveolar process and the body of the bone. It gradually increased

in size becoming about two inches long and one and a-fourth inches thick. A dentist removed the tooth, which gave little relief. When the tumor enlarged again, the man went to a physician, who lanced the growth. A thick, clear fluid mixed with blood poured out. This was repeated at intervals seven times with the same result. Pus was never seen. Finally the tumor increased so much in size that its removal became necessary.

On admission to the hospital the man presented a tumor of the lower jaw evidently within the bone, expanding it and giving a little crackling sensation when firmly compressed, as if the bone covering was of about the thickness of an egg-shell. An incision was made along the inferior border of the jaw; the periosteum of the bone was elevated and the thin wall of bone was readily broken down. Beneath this was a cyst filled with a thick mucoid material. The cavity in the bone was lined with a smooth mucous membrane. Within this was a pedunculated tumor. The alveolar process was removed anterior and posterior to the growth but the mandible was not resected.

The growth is one of those rare forms of odontomata classified as an adamantinoma, taking its origin from portions of the teeth buds and the character of the growth varies with the character of the primary portions of tooth structure which take part in the development of a tooth. Microscopically, on superficial examination, the specimen resembles an epithelioma, but the growth never causes any pain, nor, once well removed, recurs.

DR. THOS. L. GILMER thought that the case of tumor of the jaw reported by Dr. McArthur taught a valuable lesson. It showed that surgeons should not be too hasty in advising removal of the jaw or sections of it, especially of the mandible, because it produces a very serious deformity, one which is remedied only with difficulty. He thought the tumor shown probably had its origin in the persitent portions of the epithelial cord of the enamel organ. He referred to several cases of tumor seen by him, odontomas and cyst-like tumors, one of which contained a number of denticles or imperfectly-developed teeth.

DR. D. N. EISENDRATH referred to an article by Dr. Bloodgood in *Progressive Medicine* of December, 1905, describing a case of tumor of the jaw producing enormous enlargement, which he termed a cystadenoma, which he thought is probably

the best name for this class of tumor. These tumors are comparable to those occasionally occurring in the ovary. He thought Dr. McArthur's case particularly interesting because there was only one cyst, whereas in the other cases published there have been multiple cysts, each cavity being lined by a membrane similar to the one in Dr. McArthur's case.

HEMANGIOENDOTHELIOMA OF AXILLA.

DR. L. L. McARTHUR demonstrated a specimen obtained from a case of apparent recurrence of a carcinoma of the breast, in the axilla. The recurrence took place about three months after the breast had been resected. The tumor was of considerable size. The X-ray proved ineffectual. Clinically the tumor presented all the characteristics of a recurrent carcinoma. On microscopic examination of the original tumor it was pronounced a sarcoma; however, the pathologists in this city pronounced it an endothelioma of the perivascular type, a hæmangion endothelioma perivascularis. The slides were presented because on superficial examination they present the characteristics of the most malignant groups, but on close study will be seen to be as described, and therefore requiring less radical interference and giving a more hopeful prognosis.

SARCOMA OF THIGH.

DR. A. J. OCHSNER reported a case of sarcoma of the thigh and exhibited the leg which had been removed that day. He made use of a method which is exceedingly simple and effective. It is a revival of a method in almost universal use fifty or sixty years ago. He read a number of reports of hip-joint amputation which were published in Virchow's Archiv about the middle of the last century, which seemed to be so uniformly favorable that he concluded to give the method a trial. It consists in ligating the femoral vessels primarily and then grasping the other vessels as the dissection is proceeded with. The hip can be amputated in a short time with the loss of almost no blood. The sciatic and the anterior crura nerves in this case were injected with cocain.

The tumor in this case evidently was the result of repeated traumatizing of the thigh incident to the patient's occupation.

Stated Meeting, June 15, 1906.

Dr. A. K. STEELE, President, in the Chair.

CERVICAL RIB.

DR. WM. HESSERT exhibited a girl aged sixteen, who had applied for treatment of a fractured clavicle. On examination a bony tubercle was found over the inner aspect of the clavicle. This tubercle was the anterior extremity of a bony process which could be followed by palpation backwards and inwards. The x-ray examination showed a cervical rib (Fig. 1.). There had been no symptoms of pressure on the nerves or artery, nor anything else that would draw attention to the malformation.

CARCINOMA OF THE THYROID GLAND.

DR. A. E. HALSTEAD reported the case of a man, aged forty-two, with a negative personal and family history, who had had an enlargement of the neck for about eleven years. During the past few years the tumor had increased in size considerably and other tumors appeared in the neck region. The dyspnoea finally became so severe that an operation was necessary. The operation was performed under local anæsthesia and all the masses were removed. Microscopic examination of the cervical lymph-glands showed an adenocarcinoma. Besides the carcinomatous growth the tumor mass itself showed nearly all the varieties of goitre, including hypertrophy, colloid degeneration, cysts, calcareous deposits and bone. The tumor surrounded the trachea and pushed it over to the left, crowded down into the thorax two inches below the sternal notch. The patient made a good recovery and is now enjoying perfect health.

DR. E. W. ANDREWS referred to a case of tubercular degeneration of the thyroid. The patient had several tubercular glands in the neck and then developed a small cold abscess in the thyroid. After pulling out shreds of thyroid tissue for several weeks, he finally enucleated the whole gland as a necrotic mass. The patient developed symptoms of myxoedema and later died suddenly.

DISLOCATION OF METATARSO-PHALANGEAL JOINT.

DR. HALSTEAD reported the case of a male patient, aged 18 years, who had his foot caught in an elevator, causing a dis-



FIG. 1.—Cervical rib.

location of the metatarso-phalangeal joint of the big toe and fracture of the second tarsal bone as well as a Pott's fracture. Several attempts were made to reduce the dislocation under anæsthesia, but all failed. Finally an open operation was done and the dislocation was reduced. It was found that it was not the short flexor but the long flexor which had become lodged between the head of the metatarsal and the base of the phalanx and was preventing reduction. As soon as the long flexor was pulled out with a blunt hook, reduction was accomplished without any difficulty whatever.

DR. E. W. ANDREWS cited a parallel case of dislocation of the thumb in which he made a small incision and by prying with a flat director he managed to slide the phalanx on to the metatarsal, where it stayed.

DR. D. A. K. STEELE reported a similar case of dislocation of the metatarso-phalangeal joint of the big toe following an elevator accident. Repeated attempts by a local physician to reduce the dislocation, even under anæsthesia, had failed. Dr. Steele, recognizing the irreducibility of the dislocation, did an open operation and found that it was the long flexor that was lying between the bones and prevented reduction. Even strong leverage failed to effect reduction until the tendon of the long flexor was withdrawn when reduction was effected very easily.

INTESTINAL OBSTRUCTION FROM MECKEL'S DIVERTICULUM.

DR. WILLIAM M. HARSHA reported the history of a woman aged thirty-seven; who during the past two years had had one or two attacks of severe cramps in bowels without serious disturbance; no history of injury or intra-abdominal inflammation. When suddenly, May 8, 1906, she was seized with severe abdominal pain, beginning at pit of stomach, soon localizing below and to the right of umbilicus. Vomiting ensued in a few hours and continued at intervals for five or six days. Obstinate constipation, enemas only bringing away small amounts of fecal matter and very little flatus. Vomiting became intestinal, but not distinctly fecal. No temperature until third day. Slight chill, followed by temperature of 101° .

Examination:—Patient well nourished; heart, lungs, and kidneys normal. Pulse 110. Temperature 99.8° . Anxious

expression. Abdomen somewhat distended and sensitive. Through vagina soft resistance found in front of pelvis, feeling like a moderately-distended cyst, but no fluctuation could be elicited.

May 15, 1906, at the Chicago Hospital, the abdomen was opened by a median incision; considerable serum, slightly blood-stained, in peritoneum. Enormously distended, injected and oedematous intestine rolled out, which proved to be the ileum. At one point the peritoneal coat was ruptured transversely for more than one inch, which rent was sutured. Following the inflated gut down, the operator came upon a constricting band, which was clamped and cut. This band proceeded from a Meckel's diverticulum which was at its base nearly the size of the normal ileum, had a mesentery, and was not more than ten inches from the ileocæcal junction, and about three-quarters of an inch long. (Fig. 1.) The distal end, or constricting band, after passing over the ileum, penetrated the mesentery of the ileum, and seemed to be joined to, or to have proceeded from, the mesentery of the diverticulum. After ligating in two places it was cut, and when the distal stump was released from the clamp it withdrew through the mesentery of the ileum and was lost to sight, leaving a hole in the mesentery.

There were no adhesions or evidences of inflammatory changes about the intestinal tract. The appendix was normal in appearance, with no adhesions. The ileum when released presented on its upper half a deep groove, almost a cut into or through the peritoneal coat; a suture or two closed this groove (Fig. 2). The gas passed into the former collapsed portion of the ileum, relieving the great distention above. The intestine seemed viable and the abdominal wound was closed without drainage; at the end of four days, however, a fistula was formed, and fecal-smelling fluid escaped for a few days, when the wound closed spontaneously and the patient went home, about the twenty-fifth day after operation.

The diverticulum was ample in size, short—less than one inch long—and had a short mesentery. The band was ligated at end of diverticulum, and was not more than two inches long to its point of penetration of the mesentery of the ileum.

Dr. A. E. Halstead has ably reviewed the *modus operandi* of obstruction from this cause, reported in the ANNALS OF

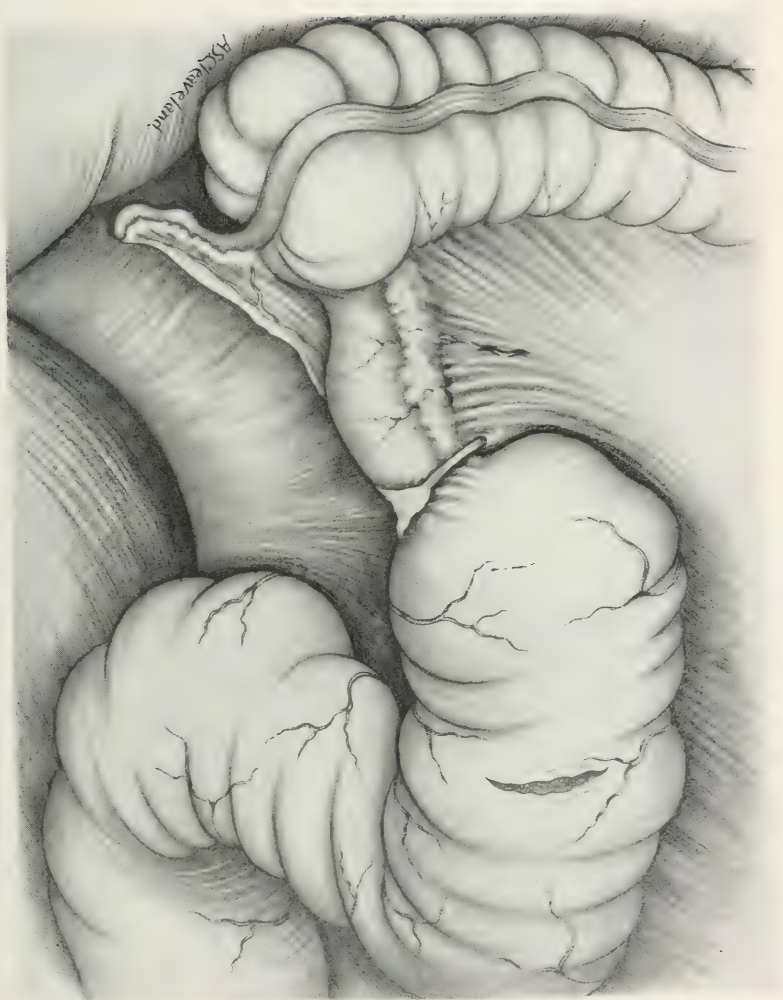


FIG. 1.

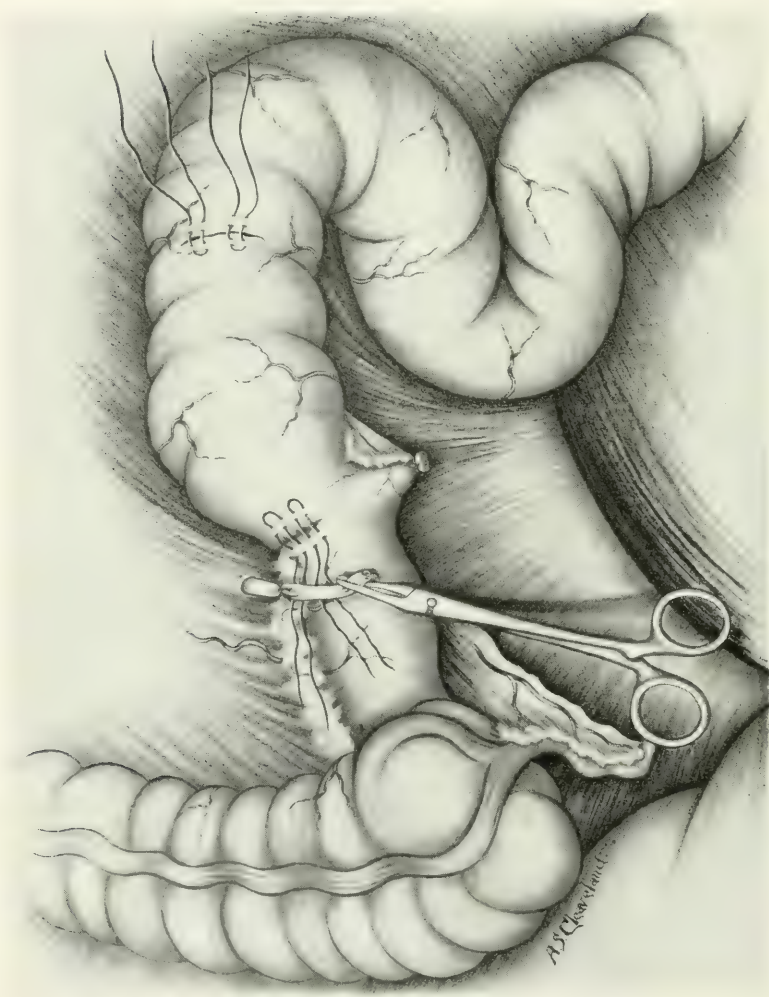


FIG. 2.

SURGERY, Vol. 35, p. 471, and in the *Journal of the American Medical Association*, Sept. 23, 1905, Dr. Miles F. Porter reviews 184 cases.

The short band crossed over the ileum from below and penetrated the mesentery of the ileum above it. The diverticulum was at right angles to the ileum and extended straight downward from the lower side of the intestine. The attachment of the distal end of the band was to some point beneath the mesentery, apparently to the root of the mesentery of the diverticulum. It is easy to see how obstruction could be caused by a sudden distention of the upper end of the ileum by either gas or fecal matter, especially when the patient was standing.

The attachment of the distal end of the band was such as to presuppose it original or primary. It could not be accounted for in the ordinary way—*i.e.*, that as the remains of the vitelline duct it had broken loose from the umbilicus and penetrated the mesentery of the ileum above to form so strong an attachment below or under it.

The most reasonable explanation is that in this case the band at the distal end was the persistent omphalomesenteric vessels. This is the view of Ahlfield quoted by Bunts (*ANNALS OF SURGERY*, V. 40, p. 537), of Halstead and others, and traction by such a band could easily account for such a diverticulum.

The history of previous attacks of severe colic, the sudden onset, the localization of pain below and to the right of the umbilicus, the moderate distention, obstruction all but complete and intestinal vomiting probably should have suggested the character of the obstruction, but so similar are the symptoms in some other forms that only a diagnosis of obstruction was made.

In addition to the other symptoms, the yielding tenseness in the anterior part of the abdomen on vaginal examination is important, showing in the absence of fluctuation unusual intestinal distention.

The frequency of obstruction from this cause is figured at 5 per cent., and the mortality at over 50 per cent., in operated cases, while taking all cases it is 60 per cent., or more. The fact that in many cases at operation the cause has not been discovered, as shown at autopsy; and that the mortality in all operated cases is so high, should emphasize the need for early opera-

tion in all cases of obstruction. The diverticulum is found in about 2 per cent. of cases. A recent report by O. M. Gilbert, in the *Journal of the American Medical Association*, May 26, 1906, shows in nearly 100 autopsies 5 per cent.

Constriction was by band in 101 of 184 cases reviewed by Miles F. Porter (*Journal of the American Medical Association*, Sept. 23, 1905), and the average age of patients about 21 years, with greater frequency in males.

It is probable that traumatism is the exciting cause in some cases, as are undoubtedly overeating and flatulent indigestion. These especially figure in etiology in diverticula with attached bands. While a review of reported cases show very few diagnoses prior to operation, there is a history of abdominal crises in many; and late operation is the only explanation of the heavy mortality. Therefore, early operation should be the rule when obstruction occurs and interval exploratory operation should be done when attacks are recurrent.

In operations for appendicitis, when that organ is found healthy the ileum should be investigated, otherwise the cause of the symptoms may be overlooked. At operation the diverticulum should be excised, as a rule, but where it is little more than an enlargement of the ileum and the patient in bad condition, as in this case, there is justification for leaving it, after removing the constricting band. The danger of trouble from the remaining small diverticulum of this type from inflammation, invagination or torsion is infinitely less than from an appendix vermiformis, and yet we do not advocate removal of an appendix in every abdominal operation as a preventive measure.

As to the rarity of intussusception, Kammerer (*AN. SURG.*, Aug., 1897) cites only two, which have been often referred to, from Treves. Gibson, quoted by Wainwright (*AN. SURG.*, Vol. 35, p. 33) does not mention this form in 239 cases of intussusception, detailed—or in 1000 cases of intestinal obstruction.

Volvulus would be clearly impossible in a very short diverticulum with a mesentery and diverticulitis would likewise be very unlikely.

DR. A. E. HALSTEAD stated that statistics showed that next to intussusception obstruction from diverticulum is the most common form of obstruction of the bowel. The statistics of Lichtenstein showed that 39 per cent. of obstructions are caused by

intussusception and 6 per cent. by diverticulum. He thought that Dr. Harsha's case was of considerable interest because the constricting band had been present from birth and did not produce obstruction for many years. The immediate cause of obstruction was undoubtedly some acute distension of the bowel above the point of constriction, which happens frequently in these cases, especially when the loop of bowel is suspended by a diverticulum from the umbilicus. When the loop becomes over-distended the weight of the suspended loop will cause a twist in the gut or constriction or other acute complication and there is an obstruction. When the diverticulum is free the chances for a constriction are comparatively slight.

He thought that not removing the diverticulum is a mistake. There are on record some thirteen or fourteen cases of obstruction occurring from invagination of the diverticulum. In some of these cases the diverticulum was only a small pouch but it was sufficient to act as starting point of an intussusception, which later caused a complete obstruction. It is therefore always advisable to remove the diverticulum, no matter how small it may be, by cutting it off flush with the intestinal wall and closing the opening with suture. These diverticula that cause obstruction by invagination do so in different ways. In some the mucous membrane loosens and alone projects into the lumen of the gut. In others the whole diverticulum is invaginated, and in still others the diverticulum weakens the wall of the gut so that a segment above the diverticulum is invaginated into the gut below.

GANGRENE OF LEG FOLLOWING RHEUMATIC ENDOCARDITIS—AMPUTATION.

DR. WILLIAM M. HARSHA reported the history of a woman aged fifty-two who had had occasional attacks of articular rheumatism since the age of seventeen; otherwise healthy; no arteriosclerosis. March, 1904, suffered an acute attack of articular rheumatism hands and feet swelling first. Various joints of extremities were successively affected until the second week, when endocarditis developed, the extremities improving except that some pain continued in right leg and knee. Suddenly there was an accession of pain in leg, which soon changed color, and beginning gangrene appeared in toes and foot.

Dr. Harsha first saw her with Dr. Lodor, of this city, April 13, 1904, when the discoloration had extended above the ankle. Left leg and foot were normal. Valvular murmurs were present in heart, but circulation seemed strong. The rheumatic symptoms had otherwise subsided and temperature was normal. April 23, 1904, he amputated at the junction of middle and upper thirds of thigh, the main artery being found closed with blood-clot up to that point.

At time of operation, Lakeside Hospital, April 23, 1904, very slight valvular sounds could be heard, otherwise organs were healthy, barring a trace of albumin in the urine. Healing was slow, the wound sloughing in a portion of one flap, and slight necrosis of end of bone followed without apparent infection, but apparently from insufficient blood-supply.

No microscopic examination of the artery was made. It appeared at each of several places opened, as a typical thrombosis or coagulum of blood; and in gross appearance the artery appeared free from inflammatory changes. The patient made a complete although slow recovery and has remained well.

His conclusion was there were vegetations or thrombi about the valves as a result of the endocarditis, which became dislodged and occluded the lower end of the popliteal, at the bifurcation probably.

SPONTANEOUS FRACTURE OF THE FIBULA.

DR. WILLIAM M. HARSHA reported the history of a man, aged 40; referred by Dr. G. V. Wyland. Father died at ninety-seven of old age. Mother living, eighty-seven. One sister died of typhoid at age of thirty-eight. One brother operated on for tuberculosis of testicle. One brother died from injury to back from heavy lifting, after several months.

Personal History.—Fell in a well at thirteen years of age, bruising left leg, following which had osteitis or periostitis, probably tubercular, lasting three years. At operation removed most of tibia. Since that has been well. Left leg five inches shorter than right. Knee presented appearance of backward displacement of bones of leg. Patient walked with cane and steel extension shoe. Was strong enough to carry weight of 100 pounds or more, and seemed entirely well. Five weeks ago went down town, and on entering a barber shop, while walking, felt bone of



Gangrene of leg.

leg break. A plaster bandage was put on by Dr. G. V. Wyland, but at end of four weeks there seemed no effort at union, and patient desired amputation.

Amputation by short lateral flaps through knee joint, at West Side Hospital, June 6, 1906. Upper two-thirds of tibia absent. Head of fibula in popliteal space, just above and slightly to inner side of external condyle of femur. Patient has made rapid recovery, sitting up before the end of a week.

Specimen shows absence of tibia, with great increase in size of fibula. Dr. W. A. Evans after having examined some decalcified pieces of the fibula, found no evidences of sarcoma, carcinoma or tuberculosis.

The fibula shows increase in size, compensatory, and appears more than usually porous. Patient is well nourished, with no organic nerve disease, cancer, diabetes, specific trouble or premature senility. Owing to the feeble articulation behind the outer condyle, it is probable that partial loss of function accounted for the weakness.

SARCOMA AND MYOMA OF THE STOMACH.

DR JOHN L. YATES, of Milwaukee, by invitation, read a paper with the above title (for which see page 599).

DR. A. J. OCHSNER said that the fact of finding three tumors of the stomach that were not carcinomatous within a short time tended to show that these tumors are much more common than has hitherto been supposed, and that tumors which are sarcomatous or myomatous may be diagnosed as being carcinomas. This seems to be important from the fact that the stomach is fairly well protected against transmission of sarcoma to the surrounding tissues. The sarcoma seems to remain more limited than does carcinoma, so that the end results should be better after gastrectomy in sarcoma than in carcinoma.

Regarding the case of sarcoma of the cæcum, he directed attention to a few points in the technic of its removal. The method of removal is comparatively simple, provided the operator bears in mind a few points. The healthy end of the colon can be inverted precisely as can the duodenum after gastrectomy, provided one goes back far enough from the tumor, the loss of a few inches of bowel being insignificant. It is important to bear in

mind the fact that the duodenum comes over to the right near the ascending colon.

Heretofore he has always made the anastomosis between the ileum and colon with the Murphy button, with a few exceptions. In the case reported by Dr. Yates it was made with the needle and thread, a method he has employed lately for everything. He removed the cæcum and ascending colon to the hepatic flexure, together with three or four inches of the ileum.

DR. A. E. HALSTEAD cited the case of a young man seen a few years ago with a movable tumor of the stomach. He had no stomach symptoms, excepting epigastric soreness occasionally. He operated on the man and found a pedunculated tumor of the size of a small orange, which resembled a foreign body more than a tumor. The tumor was attached to the smaller curvature. The portion of stomach giving attachment to the tumor was excised, and the patient made a complete recovery. The patient disappeared so that it has been impossible to learn whether or not a recurrence took place. Microscopic examination showed the tumor to be a round-celled sarcoma.

DR. D. A. K. STEELE has seen a number of cases of sarcoma of the stomach, but they were secondary. All the patients died. The first patient was a young man, eighteen years of age, who received a blow on the right testis while playing ball. This was followed by inflammation and the development of a sarcoma. The testis and cord were removed thoroughly and carefully, but within a few weeks there was involvement of the mesenteric glands, and in four months the man had a large sarcoma of the stomach which proved fatal in a few weeks.

Another patient was twenty years of age. He received an injury of the inner condyle of the femur, which was followed in a few weeks by the development of an osteosarcoma. The leg was amputated at the middle of the femur and the patient made a good recovery, but in four or five months sarcoma developed in the flexor muscles of the forearm following unusually severe exercise. The muscles were removed and the man was well for three or four months, when he developed a sarcoma of the stomach which caused his death, about sixteen months from the time of appearance of the primary tumor of the femur.

DR. E. W. ANDREWS agreed with the remark about the possibility of there being a greater number of sarcomata of the

stomach than was supposed. He thought that this might be of clinical importance in changing the attitude of the profession toward gastro-enterostomy in cases where radical removal is impossible. He did not agree with Drs. Mayo and Billings and others who condemn palliative operations on the stomach. When only one out of many cases is benefitted, it is worth while having operated. It is possible that only in these cases of sarcoma of the stomach life may be much prolonged and a patient who lived for years after the operation for removal of a malignant growth of the stomach in all probability had a sarcoma and not a carcinoma. We do not commonly get a microscopical diagnosis when we merely do a palliative operation, leaving the tumor. We could do so, and ought to do so hereafter, instead of assuming them all to be carcinoma.

DR. YATES called attention to Fenwick's statistics showing that in a series of 500 cases of tumor of the stomach, sarcoma was present in two to four per cent. Of six or eight patients that have been operated on by thorough extirpation, 40 per cent. were alive at intervals of from two to twenty-four months after operation. It is impossible to state whether the tumor was a spindle-celled or a round-celled sarcoma. In the former the prognosis is better than in the latter. As a rule, they grow from the external side of the submucosa, grow outward and have less tendency to produce metastasis. The excision of these tumors is followed by better results than is excision of the round-celled variety, which begin from the inner side of the submucosa and tend to recur or metastasize.

REVIEWS OF BOOKS.

BODILY DEFORMITIES. By E. J. CHANCE. Edited by JOHN POLAND, F. R. C. S. London: Smith & Co.

This is the second edition of a series of lectures delivered by the late Mr. Chance to his students over fifty years ago and edited by his associate, Mr. Poland, and, by the editor's comments in foot notes, brought more up to date. There is much interesting reading and many good suggestions to be derived, but it would seem to the American reader at least that a good deal more of the original lectures might well have been omitted, especially some of the discussions on controverted points. The introduction deals with the history of the development of specialism in general as well as of orthopedics, which, being written in the early beginning of this specialty is instructive, and also, in the light of present day knowledge, amusing. In the following six lectures, which make up this first volume, the author discusses the causes of congenital and acquired deformities. The book gives a profound and scientific study of the etiology and pathology of the subject, including a discussion of the hereditary and emotional influence on the development of the ovum, and the causation of congenital deformities from arrest of development, mechanical interference, and disease in utero. The last two lectures treat of acquired deformities, taking up rhachitis and tuberculosis—the latter very briefly—and dealing at length with the causes affecting the contractile power of muscles, resulting in paralyses, spasmodic action and contractures. The illustrations are numerous, but seem very crude in comparison with the finished reproductions of photographs in modern works. The reader will be well repaid by its perusal, but must wonder how many volumes would be required if the subject were treated as exhaustively to-day. There is much however, relative to the etiology, which recent treatises on orthopedic surgery do not attempt.

CHARLES DWIGHT NAPIER,

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ORIGINAL MEMOIRS.

DISLOCATION OF VERTEBRÆ IN LOWER CERVICAL REGION, FOLLOWED BY SYMPTOMS OF COMPLETE SEVERANCE OF THE SPINAL CORD; LAMINECTOMY; LATER PARTIAL RESTORATION OF FUNCTION.*

BY WILLIAM C. KRAUSS, M.D.,

OF BUFFALO, N. Y.

CASE HISTORY.—Fred. M., twenty-two years of age, a healthy, athletic young man, after diving into shallow water, July 4, 1905, became semi-unconscious and devoid of power over his arms and legs. A masseur, who was present when he was removed from the water, asserted that when he then examined him there was a dislocation of the spine in the cervical region which he reduced on the spot by manipulation. Four hours later he was received at the Buffalo General Hospital, in the following described condition:

There exists total paralysis of both legs; the arms and hands are partially paralyzed. Speech, eyes, pupils and facial muscles are not affected; the head is slightly retracted, but moves in all directions, with some pain, however. A careful examination of the spinal column does not reveal any fractures or dislocations. There is some tenderness about the spinous process of the fifth cervical vertebra, also some indefinite pain about the third thoracic

* Read before the American Neurological Association, June 5, 1906.

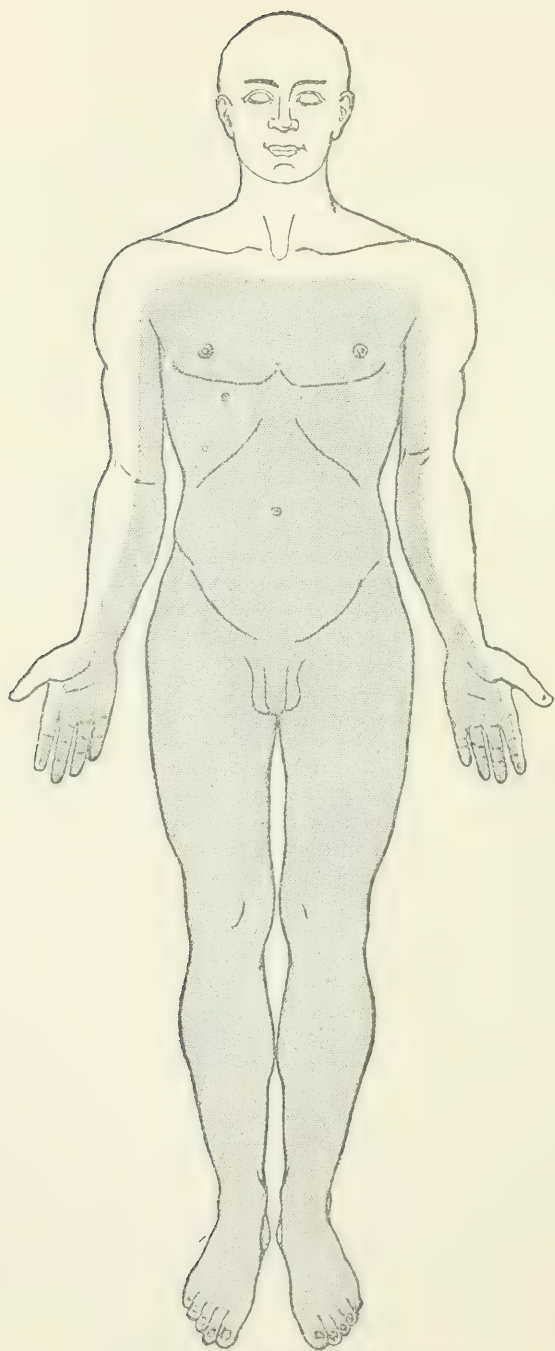


FIG. 1.—Area of total paralysis of sensation.

spine. The pulse is slow, but full, regular and of good tension. The heart is normal; no temperature.

The patellar, ankle and plantar reflexes are absent. Marked priapism is present; catheterization is necessary. The patient is able to flex the arms but not to extend them. He was transferred to the surgical ward, in charge of Dr. William C. Phelps, with whom I saw him on the following day, July 5, 1905.

Examination shows him to be a man five feet eight inches in height, weighing 150 pounds; muscles well developed; offering no scars, contusions or discolorations of any kind on his head or body. There is absolute loss of motion of the trunk and legs; limited motion of the arms, and rather free motion of the head, but attended with pain. He lies with head somewhat retracted because of relief from an aching pain when the head is flexed. As he lies on his back, the respiration attracts attention, in that there is no chest expansion, no movement of the thorax whatever in inspiration or expiration. On the contrary, the abdomen is unusually active in respiration, showing the well-marked characteristics of abdominal or diaphragmatic breathing; thoracic breathing is absolutely wanting. Extreme priapism, causing the patient considerable pain and inconvenience, is present; the head and face offer nothing abnormal. The dorsum of neck about the fifth and sixth cervical region is painful to pressure, but no crepitus or deformity of any kind is discoverable; the spine caudad of the painful area is normal.

The Arms; Motion.—Movements of the thumb and fingers are impossible. Extension and flexion of the forearms are possible but greatly weakened. Adduction of the arm, pronation and supination of the forearm are very weak. There is considerable weakness of the deltoids, biceps, triceps and chest muscles; also the muscles about the scapula, which has the appearance of the "winged scapula," due to paralysis of the serratus magnus. Triceps and biceps tendon reflexes are absent.

Sensation.—There is a zone of anæsthesia corresponding to the level of the second intercostal space ventrally, limited to the ulnar side of the arm and forearm, including the middle, ring and little fingers (Fig. 1). The thumb and forefinger only give normal sensation. The limitation of anæsthesia affects both arms symmetrically, and is for both temperature and tactile senses. The abdomen is tense; the abdominal reflex is lost; likewise the

cremasteric. Priapism noted, makes catheterization painful. There is involuntary discharge of feces.

The Legs.—Absolute loss of motion; not even the toes respond.

Sensation.—Anæsthesia is present.

Reflexes.—The patellar tendon reflexes are not obtainable even with Jendrassik's method. Achilles tendon reflex and Babinski's sign are absent; likewise the plantar reflexes.

The general condition of the patient is good. Eats well, sleeps fairly good, no pain; no temperature; pulse 85; heart and lungs are normal.

The patient was immediately placed on a water-bed and extension applied to the head.

Diagnosis.—The complete paralysis of the legs, partial paralysis of the arms, and loss of all reflexes, together with the area of anæsthesia, led to a diagnosis of complete severance of the cord. The painful area over the fifth and sixth cervical spinous processes, together with involvement of the posterior thoracic or respiratory nerves of Bell, the phrenic nerves remaining intact, pointed to involvement of the cord at the level of the sixth cervical vertebra. An operation was suggested, but denied if absolute recovery could not be promised.

During the next few days the condition remained about the same; bed-sores began to develop on the sixth day, and a mild degree of cystitis appeared. The incontinence of feces and priapism persisted, the latter under the continual use of ice and camphor monobromate subsiding partially. Reflex contractions in the feet and legs appeared, and the patient experienced darting pains in the arms and legs. The condition remaining the same as regards motion, sensation and the sphincters, his strength failing, bed-sores growing larger, and the cystitis more pronounced, a most urgent demand was made for an operation if the young man's life were to be saved. The mother reluctantly consented, and the patient was transferred to the care of Dr. Roswell Park, whose report follows:

"July 22, 1905, under chloroform, I exposed the spine between the fourth cervical and first dorsal, finding the sixth cervical apparently somewhat loosened and abnormally movable, but without fracture so far as I could discover. I removed the posterior arch of the sixth and exposed the spinal canal. Outside the dura

nothing appeared abnormal. Upon puncturing the dura a large amount of cerebrospinal fluid escaped with a jet, showing that intraspinal tension had been very much increased. After opening the dura for one inch, the cord itself showed no particular evidence of laceration or violent disturbance, but seemed to have shrunk; was flattened so that it did not nearly fill the canal. There was a small remnant of old clot within the dura. On lifting the cord with an artery needle, it seemed flattened, ribbon-like, shrunken and to lack in bulk. I could find no evidence of present displacement of the vertebræ, and examination above and below indicated that the spinal canal was ample and afforded sufficient accommodation for the cord. I closed the dura with catgut and the entire wound with buried and superficial drainage.

"The wound healed kindly. Patient remained in the hospital about four weeks and went home, showing some improvement, able to move the feet a little, and with considerable improvement in sensation. In the hands and arms not much change appeared."

The patient remained in the hospital until August 18, 1905, gaining somewhat in strength; the bed-sores had healed, the cystitis disappeared, and he was able to sit up in a roller-chair. A small fistulous opening in the operation field was still present.

His condition is as follows: With exception of the fistula, the wound has healed by first intention. He experiences no pain about the head or neck and can move the head freely. The area of anæsthesia has not changed materially; if anything it is more of a hypæsthesia. He can now feel the contact of a pin, but cannot distinguish between the sharp and dull point; temperature sense still disturbed. He has fields of hyperæsthesia located in the legs, on the soles of the feet, and on the left knee.

Motion.—He is able to raise the arms over his head, can flex the forearms, and has fairly good extension of the hand, but the flexors of the hand are weak; likewise pronation and supination. He can draw up the right leg as far as the left knee; extension and flexion of the right foot is quite strong. The left leg can be drawn up to about the middle of the right leg. Extension and flexion of the left foot present, but very weak. He has better control over the legs when lungs are inflated.

Reflexes.—The patellar tendon reflexes are markedly exaggerated. Ankle and patellar clonus present; likewise exaggerated plantar reflexes and Babinski's. The abdominal reflex

also the cremasteric are still absent. The priapism has disappeared, and he can tell when bowels and bladder are to act, but cannot control the sphincters. The breathing remains the same, being entirely diaphragmatic. Involuntary contraction of the muscles of the legs and spasmodic flexion of the legs and feet annoyed him greatly.

With directions for further treatment, he was allowed to go to his home in Wellsville, N. Y., and was placed under the care of Dr. G. H. Witter. Reports from time to time showed continuous improvement, so that in his roller-chair he was able to go back to the office, and in a small way resume his work as telegraph operator.

On April 17, 1906, he returned to the hospital for observation and treatment.

Stature.—He inclines slightly forward, but can stand for fifteen minutes without support. Romberg is slightly present. Can flex right leg upon thigh and upon pelvis, standing on left leg, but can lift left leg only three inches from floor standing on right leg.

Gait.—He is able to walk when supported, or when pushing a chair as a guide. If he could control the tendency to fall backwards, he could walk easily with a cane. The gait is spastic; he is able to lift the right leg from the floor in walking, but drags the toe of the left foot. The left leg is considerably weaker than the right. In bed he is able to draw up the right leg freely, but barely able to draw up the left. On sitting without support, he is obliged to balance the body with his feet to prevent falling backward. He says his back is the weakest part and arches out to a great degree if not supported. He has all the motions of the arms and shoulders freely.

Forearms.—Pronation and supination are good; likewise the extension of the wrist. He closes the right hand fairly well, and can write very easily and use the telegraph key with force. Dynamometric test, repeated trials, averages 30.

Left Arm and Hand.—Incomplete pronation and supination of forearm are present. He can open and close the hand but without much power. Dynamometric test, repeated trials, averages 10.

He began to use the telegraph key on November 1, 1905,

using the wrist instead of the fingers. About March 1, 1906, he telegraphed easily and sent 5000 words over the wire.

Circumference.	Right Arm.	Forearm.	Left Arm.	Forearm.
Upper third, . . . 10	inches.	9¾ inches.	9¾ inches.	8¾ inches.
Middle third, . . . 9	inches.	7½ inches.	8¾ inches.	7 inches.
Lower third, . . . 8¼	inches.	5¾ inches.	7½ inches.	5½ inches.

Faradic irritability of the right and left arms and legs is well preserved. There is no marked difference between the two sides.

Reflexes.—The tendon reflexes of the triceps, biceps and forearm muscles are exaggerated. Muscle reflexes are also heightened. The abdominal and cremasteric reflexes are absent. The tendon reflexes of the legs are all exaggerated—patellar, achilles; Babinski's sign can be elicited by simply touching the soles of the feet. Patellar and ankle clonus are present and the plantar reflexes are unusually active.

Sensation.—There is still some difference of sensation at the level of the original zone; a mild degree of hypæsthesia still exists. In the left leg, temperature and tactile sense are normal, but in the right leg, although the patient can feel the condition of the leg and foot as to being warm and cold, he cannot distinguish between hot and cold applications to the leg. Tactile sense is normal. Breathing is still diaphragmatic. The bowels are constipated, bladder functionates normally and priapism has long since disappeared. The scar, five inches in length, extends from the third cervical to the second thoracic vertebra. The spinous processes of these vertebræ are gone.

The subject of severe injury to the cord through fracture, gunshot or other insult, has received considerable attention during the past few years, and was a topic of general discussion at the 1905 Meeting of the American Surgical Association. It seems to be agreed that however severe the lesion, even to complete severance of the cord, surgical measures should be resorted to as soon as possible. The symptoms of complete severance of the cord as stated by Thomas¹ are:

1. Complete paralysis, usually of a flaccid type.

2. A complete loss of sensation in all its forms.
3. Absent reflexes, especially the knee jerk, while the plantar reflex, on the contrary, is often retained.
4. Complete paralysis of the bladder and rectum, with priapism.
5. Vasomotor paralysis, with severe sweating in the paralyzed parts.
6. And most important absence of variations in the symptoms.
7. Absence of irritative phenomena, such as pain.

Walton ² in a comprehensive paper on "Spinal Fracture with special reference to the question of operative interference," arrived at the following conclusions:

(1) There are no symptoms which establish (otherwise than through their persistence) irremediable crush of the cord.

(2) While total relaxed paralysis, anæsthesia of abrupt demarcation, total loss of reflexes, retention, priapism and tympanitis, if persistent, point to complete and incurable transverse lesion, the onset of such symptoms does not preclude a certain degree at least of restoration of function.

(3) The prognosis without operation is grave.

(4) While the results of operation are not brilliant, they are sufficiently encouraging to warrant us in making the practice more general.

(5) In most cases it will be wise to operate within a few days of the injury, but a delay of some hours is advisable, partly on account of shock and partly to eliminate the diagnosis of simple distortion.

(6) We have no infallible guide to the extent of the lesion. The operation at the worst does not materially endanger life nor affect unfavorably the course of the case, and may at least reveal the lesion and lessen the pain; it may sometimes save a patient from death or from helpless invalidism of most distressing character. Instead of selecting the occasional case for operation, we should rather select the occasional case in which it is contraindicated (the patient with great displacement

of vertebræ, the patient with high and rising temperature, the patient plainly moribund, the patient still under profound shock).

(7) The dura should be opened freely; it need not be sutured; drainage is not necessary.

Burrell³ in a summary of all the cases of fracture of the spine which were treated at the Boston City Hospital from 1864 to 1905, states his conclusions as follows:

1. That fractures of the spine may well be divided into two classes: first, fractures of the spine with injury to the cord; and second, fractures of the spine without injury to the cord.

2. That it is not best to decide what the treatment of an individual case of fracture of the spine should be from the statistics, because the lesion varies so widely.

3. That in many cases of fracture of the spine it is impossible to primarily state whether the cord is crushed or pressed upon by bone, blood or exudate except by an open operation.

4. That only by the persistence of total loss of reflexes, complete insensibility to touch and pain, and motor paralysis below the level of the lesion can total transverse destruction of the cord be diagnosticated.

5. That if pressure on the cord is allowed to remain for many hours, irreparable damage to the cord may take place.

6. That unless it is perfectly clear that the cord is irretrievably damaged, an open operation to establish the condition of the cord and to relieve pressure is imperative as soon as surgical shock has been recovered from.

7. That in certain cases of fracture of the spine, when the cord is not injured, but is liable to injury from displacement of the fragments of a vertebra, rectification of the deformity and fixation of the spine may be used.

8. That if the cord is crushed, no matter what treatment is adopted, there will, of necessity, be a high rate of mortality.

There is no question but that a complete transverse lesion was present in the case reported, by the appearance of the cord as found by Dr. Park and by the symptoms and their persistence up to and following the operation, fifteen days after the

injury. That a very decided regeneration of the cord has taken place, with a remarkably excellent result, is evidenced by his condition as stated at the present time.

In the Stewart-Harte case, the operation was performed three hours after the injury, a gunshot wound completely severing the cord, and regeneration did occur.

Fowler⁴ in his paper in the symposium of spinal-cord lesions, reported a case in which a bullet-wound was received at the tenth and eleventh thoracic segments, completely severing the cord, in which an operation was performed and the cord sutured ten days after the operation. Regeneration of the cord followed and a partial recovery of the patient has taken place.

A timely experimental investigation of the occurrence of traumatic degeneration and regeneration of the spinal cord has been recently made by Fickler,⁵ who experimented on the lower animals. As the result of the study of the process of regeneration in the spinal cord, Fickler notes the following:

“The regenerative phenomena following experimental lesions of the cord in animals are not as marked as those following compression of the cord in human beings. Section of the white substance between the anterior horns and the periphery is followed by regeneration of reserve fibers above and below the plant of section. A regeneration of ganglion cells in the cord has not yet been observed. Regeneration of nerve fibers occurs in many diverse diseases of the cord, whether the disease has already run its course or whether it is slowly developing; it occurs in traumatism, compressions, syringomyelia, and in transverse and disseminate myelitis. It does not occur in the columnar degenerations and in multiple sclerosis. In order that regeneration may occur it is necessary that the ganglion cell should be intact. The first evidence of regeneration is seen one week after the section, and the process proceeds slowly. Only a comparatively small number of fibers are restored. The functional result is not a very considerable one. The best conditions for a restoration of function in the anterior part of the cord are afforded by compression, which leaves intact the central veins and the general configuration of

the cord. A regeneration proceeding from the posterior roots in compression has not yet been found, and probably, cannot occur, since the cause of injury of the cord is a caries of the vertebræ, which causes tuberculous ulceration of the ganglia on the posterior roots, in which case no regeneration can occur."

This case is a notable one. First, because the injury undoubtedly was a dislocation of the sixth cervical vertebra, according to the report of the masseur and the loosened condition of the sixth cervical vertebra as noted by Dr. Park at the operation; second, that a crushed or pinched condition of the cord followed, as adduced by the condition of the cord at the operation, which was borne out by the clinical symptoms, answering to all the tests of a complete transverse severance of the cord; third, that a regeneration of the spinal cord followed the operation, accompanied by a descending degeneration of the cord; fourth, and that a remarkable recovery of function took place, although the operation occurred fifteen days after the receipt of the injury.

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THE OMENTUM AND ITS FUNCTIONS.

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THE concept of the omentum in the minds of most of our writers has been incompletely stated, the anatomist having the most to say in his descriptions of its various folds. Until recent years but few accurate observers have endeavored to describe its structure or numerous functions. A detailed study of this tissue brings to light many researches which give evidence of its great importance in the protection of the peritoneal cavity. It is impossible to discuss this organ apart from the conditions of the general peritoneal surface; nevertheless, owing to its histo-anatomy being somewhat distinctive, its functions are, to a certain extent, unique.

Embryology.—By the end of the first month of fetal life the digestive tract is formed, consisting of but a single tube; a dilatation in the upper part of which becomes the future stomach. This dilated portion is situated in the future thoracic cavity; has two attachments, known respectively as the anterior and posterior mesogastros; the posterior curvature becoming more pronounced than the anterior. Just below the stomach, in the third week, a rudimentary liver evaginates into the anterior mesogastrium, and in the fourth week, the pancreas into the posterior. The position of the pancreas and its early attachments to the mesial line determines the fixation of the duodenum, which is the first part of the intestinal tract to become fixed. In the meantime, the stomach descends toward its future normal position, rotating at the same time, so that what was the posterior border becomes the inferior, and the anterior, the superior. The posterior mesogastrium becomes redundant, out of proportion to the requirements of its visceral connections, and, to some extent, independent of the

direct mechanical purpose of carrying blood-vessels to the viscera.⁶

The growth of the spleen carries the attachment of this membrane to the left. The posterior, or right surface of the mesogastrium, forms the cavity which is known as the cavity of the lesser omentum.

At, or soon after, birth there is a cohesion of the posterior layer of the omental fold with the transverse mesocolon. By this cohesion the pancreas becomes covered and the buried peritoneal surfaces absorbed, areolar tissue taking its place. Through this, the transverse colon seemingly becomes a part of the descending layer of the omentum.

Anatomy.—Another entirely different view of the omentum is obtained from the study of general anatomy. From time immemorial, and practically without any alteration in detail, anatomists have contented themselves with a description of the omentum as being “a complicated folding of the peritoneal surfaces,” submitting careful descriptions of the several layers with their origin.

The omentum is a reticulation of connective tissue, carrying a double fold of peritoneal membrane, extending from its parietal attachment on the posterior abdominal wall, down more or less deeply into the abdomen, then up to become attached to the lower portion of the stomach and gastro-splenic ligament. The retrogastric space, which includes the space between the folded peritoneum not obliterated by adhesions of its surfaces, is known as the cavity of the greater omentum. Its connection with the general cavity is at the right of the stomach in foramen of Winslow. This cavity varies in size; in childhood extending down into the fold of the omentum; or, owing to adhesive obliteration of the lower sac in adults, or absorption, this cavity often does not extend much below the lower margin of the stomach.^{2, 6, 17}

The omentum possesses a remarkable vascular supply; its arteries coming from the gastro-epiploic, right and left; its veins empty into the portal vein. No nerves have been demon-

strated; nevertheless, vasculomotor and trophic nerves must exist to innervate the different structures contained.

The lymph-stream is abundant and empties into the glands on the greater curvature of the stomach; in some cases fifteen or more may be seen. The majority are found between the greater curvature and the transverse colon, although some may extend below the lower border of the colon.^{9, 16} The lymph-stream, after it passes the first chain of glands, empties into the retroduodenal, and from there into the receptaculum chyli.¹⁴

According to A. S. Warthin, hæmolymp glands of the splenic type are found, their position not being stated.²¹ Melissinos, however, says that they are more numerous between the spleen and greater curvature of the stomach.

According to Robinson, many times in a hundred autopsies the omentum is entirely out of sight, rolled up above or under the transverse colon. In 10 per cent. of the cases it may cover the cæcum, and in 20 per cent. reach into the pelvis. It tends chiefly to the left and is found in 3 per cent. of all the herniæ.¹⁸

The position of the omentum in the abdomen is determined in part by the pumping action of respiration, intra-abdominal pressure, or more largely by the peristaltic movements of the intestines. By means of the latter, the omentum is kept unfolded, and is drawn to different parts of the abdomen with the movements of the intestines, so that each portion of the peritoneal cavity is touched at times by this membrane. The descensus of the same into the abdomen will depend not only on its length, but upon the position of the lower border of the stomach.

Histology.—The ground substance of the omentum is composed of connective tissue made up of a variable amount of fibers, white and elastic. The white fibers are arranged in a reticular manner, connecting with each other. The meshes of the reticulation are occupied by the ground substance of the membrane, bridged over by the flattened cells of the surfaces. These meshes may become open in many parts owing to absorption of the intervening ground substance and the perforation of the cells covering it.¹⁷

Klein says that in those animals in which the omentum is fenestrated in the adult condition it is not, or only imperfectly so, in the young condition, being then a continuous membrane composed of a layer of connective-tissue bundles. This fenestration is produced by cavities appearing between the connective tissue bundles, which cavities open through the interstitial cement substance of the surface endothelium. A direct transition of connective tissue corpuscles into endothelial cells of the surface is hereby established.⁸ Lying upon these bundles of fibrous tissues are connective tissue nuclei or corpuscles. The corpuscles here and elsewhere belong to the fibrous tissue, and when separated from them, the bundles suffer in nutrition, and are extremely liable to die. Along with the bundles of fibers are intimately bound up arteries and veins; lymphatic vessels and lymph-canalicular spaces. The lymphatic vessels are composed of a thin endothelial wall; the lymph-canalicular spaces contain an albuminous fluid. The number of these lymph-vessels varies in different parts.⁴

The omentum is especially rich in groups of germinating cells; in many instances they are found on the surface of special thickenings of the normal membrane in connection with the vascular system. Sometimes they are found on peculiar papillary projections, particularly under pathological relations. The germinating endothelium sometimes contains cells which are in the act of division. Some are free and possess the power of amœboid movement, approaching the nature of the lymph-corpuscles. After becoming free, they find their way into the lymphatic vessels and then into the blood-vessels as colorless blood-corpuscles. In many mammals the amount of such germinating endothelium is very great, hence this membrane plays an important part in the generation of lymph and colorless blood-corpuscles.

The omentum also contains nodular or cord-like groups of adenoid tissue covered on one or more surfaces with germinating endothelium. These masses have either well-defined outlines or are more or less diffuse. According to Klein, the lymphatic tissue in the omentum, being possessed of a special

system of blood-vessels, may at one time functionate as connective tissue, or at another time as fat-cell tissue.⁸

There is a large amount of adipose tissue which, towards the end of life, particularly in those people tending to obesity, accumulates considerable fat.

The surface of the omentum consists of a layer of endothelial plates (120 mm. in thickness) which are elastic; their interstitial cement substance being very soft. According to the state of contraction or expansion of the subjacent membrane or the direction to which it is being drawn, so will the shape of these plates be altered. There is a direct transition of connective tissue corpuscles into endothelial plates of the surface.⁸

Von Recklinghausen's claim that on the surface of the peritoneal cavity were stomata through which fluids freely passed to the lymphatic channels was so plausible, in consideration of the rapid absorption of fluids from the peritoneal cavity, that it went undisputed by histologists for a considerable time, until Muscatello and others disputed the presence of them.¹¹

MacCallum, in a strong paper, controverts the statement that openings exist, and negatives the idea that the peritoneal cavity is part of the lymphatic system, and even further disputes that the endothelium has any connection with the adjacent connective tissue cells, claiming an independent development.¹¹ Sabion claims, according to embryological investigations, distinctive origins for the endothelial cells and the subjacent lymphatics.

Functions.—The several functions of this membrane are determined by the different tissues which go to make up its substance, and as this organ is insuperably connected with other tissues contiguous, much that pertains to the functioning of the omentum is associated with similar conditions existing in nearby structures. The study of one implies a knowledge of the action of all.

From the time of the early anatomists the sole function attributed to the omentum was that of protector of the intestines against chill. Like many fictions in medical literature

this has long gone without protest. Of how little value it may be to the underlying intestines can be appreciated by any one who has taken the trouble to introduce a thermometer into a deep sinus and watched for the effect of an ice-bag on its reading.

I. Circulation.—The large blood-supply of the omentum makes it an important factor in maintaining an equilibrium of blood circulation. Physiologists teach the importance of the correlation between the intraperitoneal circulation and external conditions. Necessity demands, for relief of arterial tension, that some part of the circulation be capable of storing up blood. This the intra-abdominal vessels are alone capable of doing safely, being aided by the sensitiveness of the splanchnics to reflex irritation. Surgeons frequently note that during operations long prolonged the omentum changes color and becomes turgid with blood. Crile²³ holds that shock is due to reflex vasodilatation of the splanchnic area. The omentum with its loose tissues and numerous vessels must play an important part in this phenomenon. Under conditions which increase the pressure of blood in the portal system, the veins of the omentum become distended, and from them passes into the peritoneal cavity ascitic fluid. One observer, after amputation of the omentum for some incidental condition, noted the disappearance of the ascitic condition coexisting.

The omentum in its excursions through the abdomen may become adherent to some area of local inflammation and a collateral circulation sufficient to relieve the venous tension may be established.

II. Absorption.—Another important function is attained through the vascular system of the omentum in conjunction with the lymphatics; that is, the absorption of fluids and the taking up from the peritoneal cavity of suspended solids.

Wagner²² estimates a dog's peritoneum as capable of absorbing in one hour an amount of fluid equal to $\frac{3}{8}$ per cent. of the animal's body weight. Du Bar and Remy²² found the thoracic duct of a rabbit greatly distended in five minutes after a large intraperitoneal injection of albuminous fluid: that the

greater the percentage of albumin, the less rapid the absorption.

Absorption in the peritoneal cavity is partly by the lymph-stream and partly by the blood-stream. This absorption is not only of fluids, but of insolubles. Muscatello and Salzel claim that the solid particles are carried by the wandering cells to the lymph-stream, and the fluids largely by the blood.

Various factors influence the rapidity with which fluids are absorbed in the peritoneal cavity and the amount absorbed. Only under normal physiologic conditions can the maximum be obtained. The rapidity is regulated by two factors; the pressure exerted by the abdominal muscles and the movements of the diaphragm and intestines,—the diaphragm acting like a pressure and suction-pump. The movements of the intestines prevent the accumulation of fluid in any one part, so that it cannot follow the law of gravitation. They carry the fluids over the absorbing surfaces of the peritoneum and in this way greatly enhance the absorbing powers.

According to Nothnagel¹⁴ the absorption of the intra-peritoneal fluid is directly proportionate to the activity of intestinal peristalsis. Reduction in temperature of the peritoneal cavity reduces the absorptive power of the omentum, due to diminished peristalsis; dilatation of the blood-vessels and increased peristalsis tending to promote absorption.

Dudgeon and Sargent in their book on "The Bacteriology of Peritonitis"²² claim that whatever absorption cannot take place by the lymphatic channel must be done by means of the blood-stream. Provided that the endothelium is uninjured, bacteria and other foreign substances will be safely disposed of by the lymphatic route; but damage to the endothelium will at once allow absorption to take place by the vascular route, the extreme delicacy of the peritoneal membrane rendering it particularly susceptible to injury. The factors which retard or stop absorption have been investigated by Wagner and others, and are generally pathological. Venous engorgement may increase the peritoneal content. Reduction in the energy of intestinal peristalsis, together with diminished activity of the

diaphragm, and loss of tension of the peritoneal muscles, retard absorption.

According to Byron Robinson,¹⁸ the organ that the cells of the peritoneal cavity seek to become attached to is the omentum. Oppel¹⁴ has suggested that the path taken by the lymph-stream from the peritoneal cavity is chiefly by the great omentum. He gives as his reason that in many cases where the peritoneal lymph was free from bacteria a deposit of micro-organism was found on the great omentum.

Lodi¹⁴ states that the omentum plays an extremely important part in the absorption of both microorganisms and solid particles in the peritoneal cavity. Durham found that in an animal killed twenty minutes after an intraperitoneal injection of bacteria, the omentum contained bacteria while the peritoneal cavity was sterile on culture.

Muscatello observed color particles taken up by the phagocytes, which rapidly passed between or through the endothelial cells into the subjacent lymph-spaces.

The nerve-supply of the omentum according to Marcy,¹² plays an important rôle in the organism, maintaining a suitable equilibrium of flows in the abdominal cavity.

III. Cohesive and Adhesive Properties.—The *cohesive* tendency of the omentum is first evidenced in fetal life, when the mesogastrium unites with the mesocolon through either degeneration and absorption of the endothelium or more likely a retrograde metamorphosis of endothelia into connective tissue corpuscles. This same tendency can be demonstrated in advanced life when conditions are suitable, and is often noted when the omentum becomes incarcerated in a hernia.

The *adhesive* tendency of the omentum is a property peculiar to itself, as is the *cohesive*. When this membrane is irritated either through some regional inflammation or point of disturbed circulation, there is a transudation onto its surface, as well as into its superficial structures, of an exudate composed of white-blood cells and fibrin, which produce a stickiness. This leads the omentum to become attached to the offending portion and to encapsulate it. Continued irritation

will lead to a marked hyperphasia of the omentum. If the source of irritation does not contain germs too pathogenic or too numerous, or if the phagocytes and the opsonic condition be satisfactory, the ultimate result will be a restitution and gradual absorption of the hyperplased and exuded material, and a return to normal. Not all of the endothelia being disturbed, new endothelia are formed. In the subendothelial tissue is maintained an excess of the fibroid which will materially interfere with subsequent absorption from that point. If the disturbance to the peritoneum be more or less general, there is, as we find clinically, an acquired immunity to secondary infections.

Experiments by Schlitzler and Ewald show drying of the peritoneal surfaces to be an important element in the genesis of peritoneal adhesions; at the same time it retards the rate of subsequent absorption of fluids.

IV. Protective Rôle.—The wonderful discovery by Metschnikoff of the phagocytic action of the white-blood cells receives no better illustration of its value in the economy than in the peritoneal cavity, as this tissue is greatly prone to invasion.

The slight amount of tissue separating the contents of the intestinal tract from the sensitive peritoneum, and the numerous organs subject to lesion and traumatism, render this cavity particularly susceptible to microbic invasion. Had Nature not a method of protection sufficient for ordinary disturbances, life would not be long lasting. In phagocytosis we have this means of protection and in the omentum a ready organ for its elaboration and action.

The phagocytes, drawn from the periphery by chemotaxis, associated with those formed from the transformed endothelia, the adenoid and connective tissue of the omentum, are extruded into the peritoneal cavity.

The peritoneal cavity normally contains a small amount of clear fluid in which are suspended a number of cells. The character of these cells, according to Kanthak and Hardy, is 30 per cent. to 50 per cent. polymorphonuclear.

Opie ²⁴ states that polynuclear leucocytes with fine granulations accumulate in great quantity on the surface of the omentum and form compact clumps held together by a network of fibrin. The eosinophile leucocytes in large number penetrate into these masses of cells. He further claims that the eosinophile cells rarely if ever ingest bacteria.

Dudgeon and Sargent's experiments ²² seem to demonstrate that the granular eosinophile cells, which some have considered to be non-phagocytic and others slightly so, to be one of the most important, if not the most important, phagocyte in the early stages of peritoneal infection, while the finely granular polynuclear cells become a well-known important phagocyte in the later periods of peritonitis.

These same writers claim that on irritation of the peritoneal cavity, the staphylococcus albus appears on its surface, before there is any solution of continuity. It is generally found at a distance from the focus of irritation in association with numbers of phagocytes. Their conclusion is that from some unknown source this germ enters the peritoneal cavity ahead of all other more pathogenic germs, spreads rapidly over the entire peritoneum and omentum, and, by its minor irritation induces a rapid transudation of phagocytes, thus preparing the cavity to attack more virulent germs when they appear. Thus the omentum as a surgical factor in laparotomy is comprehended.

There is a general definite relation between the lymph-flow and cell-intrusion in the peritoneal spaces,—the obliteration of the lymph-channels from the peritoneal membrane by constriction of cicatricial tissue explaining why repeated lymphangitis becomes less and less dangerous.

Roger ¹⁹ considers the great omentum a flattened ganglia. To demonstrate the protective rôle of this membrane, he extirpated the omentum in rabbits and guinea-pigs. Later, after a period of a month or two, he injected into the abdominal cavity of the animals thus operated upon a few drops of the virulent culture of staphylococcus aureus. Death supervened in twenty-four hours, or at the latest within two or three days. Controls of the same weight to make the conditions identical

having been subjected to a simple laparotomy, received the same amount of culture, but survived. It should not be concluded, however, that the extirpation of the omentum entirely destroys the resistance of the peritoneum, for the animals thus operated upon survive if they receive a very small dose of a virulent culture, or if an attenuated microbe be employed. In repeating the inoculation, however, he noticed that the animals deprived of the omentum grew thin and cachectic, and finally succumbed, while the control animal manifested no disturbance whatever. This rôle of the omentum is especially marked in the young, because with age a fatty infiltration occurs which diminishes the activity. It is, however, in children that the peritoneum is frequently threatened by microbes which swarm in the gastro-intestinal canal and so often cause inflammation there.

The plastic exudate thrown out by the omentum at the point of lesion doubtless offers some purely mechanical protection against the spread of infection; it may also be that the secretion poured out from the omental vessels has some anti-toxic action. Further, the bacteria received into the lymphatics of the omentum are either rendered less virulent, or are else destroyed.

Byron Robinson says,¹⁸ "the great omentum is a valuable peritoneal veil. It may present many cicatrices showing old peritonitis. It prevents the invasion of infection, and circumscribes inflammation. It is a great peritoneal protector, and the surgeon's friend, burying the mischief he has wrought. It may show by old inflammation that it has checked peritonitis."

Experiments by Schlitzler and Ewald¹⁴ show a property of the omentum to be the rapid formation of plastic tissues on irritation, when an engorgement of the vessels takes place.

Robinson¹⁸ claims that in nearly all experiments when congestion and peritonitis arose the most intense congestion appeared in the omentum, and thus in peritonitis in both man and animal this intense congestion of the omentum is a characteristic feature. He claims that the omentum in peritonitis attempts to corral the phagocytes, or their adherent microbes, by taking them out of the peritoneal fluid and making them

adhere to its sticky surface. Careful examination will show that it harbors microbes while the peritoneal fluid is sterile on culture, but, if the microbes be very virulent, the stickiness of the surface will not suffice to ensnare or destroy them.

According to Warthin ²¹ after removal of the omentum, animals are more susceptible to intraperitoneal injections of microorganisms. In local traumatism, after operations and in local peritonitis, the omentum is commonly found attached to the affected area, shutting it off. The slightest irritation is sufficient to cause the omentum to attach itself.

V. Supplemental Function.—De Renzi ¹ found that if the circulation of the spleen be entirely cut off, the omentum gradually envelops and forms a capsule around it, inside of which it is in time completely absorbed. If the omentum be removed after the circulation of the spleen be cut off, the organ does not become encapsulated, and the animal speedily dies. When toxins are generated by gangrenous degeneration of the spleen or other organs, the omentum seems to possess the power of neutralizing these toxins.

Pirrone ¹⁵ confirms the findings of De Renzi, and claims that the action is done by phagocytes originating in the omentum and devouring the detritus of the spleen. He compares the endothelium of the omentum to that of the blood-vessels in respect to thrombus. He claims that after extirpation of the spleen, there is nothing to indicate that the omentum undergoes modified transformation to compensate for the missing organ.

Pirrone proved the phagocytic action of the omentum. He experimented with injections of sodium taurocholate in splenectomized animals and induced immunization from this drug. When he compared the results with those obtained with nonsplenectomized animals, he found that the omentum had evidently tried to compensate for the absent spleen. Compensatory plastic processes in the lymphatic follicles were unmistakably apparent. The findings suggest functional relations between the spleen and the omentum beyond what physiologists have hitherto imagined.

Warthin ²¹ finds hæmolymp-h-glands of the splenic type

existing in the omentum, and it is possible that they may take on vicarious action, become enlarged, and functionate for the destroyed spleen.

Résumé.—1. The numerous blood-vessels and lax tissues of the omentum allow of storage of blood when the general arterial tension is high.

2. By venous anastomosis through adhesions, local congestion may be relieved.

3. Through its large surface freely exposed to surrounding parts in motion, it becomes a rapid absorber of fluids by the blood-stream.

4. By the lymph-stream it is a free carrier of white-blood corpuscles, encapsulating solid particles.

5. Through its cohesive tendency, apertures in the abdomen into which the omentum has been forced by intra-abdominal pressure become more or less completely closed.

6. Through its readiness to lymph formation and local proliferation, it becomes attached to infected parts, which are walled off, subsequently to be absorbed by phagocytic action; the peritoneal cavity thereby protected.

7. The majority of the phagocytes extruded into the peritoneum for its protection come through the omentum, largely from the general circulation, but in part from the tissues therein existing; subsequently to be attached to the surface of this tissue, taken into the lymph-stream, and subjected to the cytolytic influences existing there.

8. Lack of development of the omentum, or loss through operation, renders one less resistant to peritoneal invasion.

9. Hæmolympth-glands of the splenic type existing in its base supplement the spleen if the latter be removed or its functions interfered with.

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A FURTHER REPORT ON A CASE OF CIRRHOSIS OF THE STOMACH.

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ON January 4, 1903, an exploratory laparotomy was done on Mr. H. C. C., of Telluride, Colo. The stomach was found to be very small, its walls markedly thickened and indurated, but the organ was not deformed. Its cut surface appeared fibrous. The mucosa, as far as could be determined, was smooth and atrophic. A gastro-enterostomy was done. The case was thought to be one of benign diffuse cirrhosis of the stomach.

At this time, June 26, 1906, three and one-half years after the performance of the operation, the patient remains perfectly well. He works on his farm constantly, and eats ordinary food without discomfort. His weight and strength are fully up to the standard for a man of his age.

In reporting this case,* together with the reports of ten other cases of cirrhosis ventriculi observed post mortem by Hadden,¹ Turner,² Hanot and Gambault,³ Jacobi,⁴ Bernabei,⁵ Osler,⁶ Leith,⁷ and Allbutt,⁸ it was held that a benign diffuse cirrhosis of the stomach, though a rare condition, does occur; that it is not associated with cancer; and that cirrhosis of the stomach may be sufficiently severe to terminate the patient's life without cancerous involvement being present.

It has been a much discussed question whether a non-malignant cirrhosis of the stomach exists. The clinical and post mortem evidence indicates clearly that while it may be at times difficult, or even impossible, to distinguish between a diffuse carcinoma of the stomach and a cirrhosis ventriculi, still, in rare instances, a benign cirrhosis of the stomach does

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occur. Andral,⁹ Cruveilhier,¹⁰ Brinton,¹¹ Habershon,¹² Wilks,¹³ and most of the earlier writers, have clearly drawn the distinction. The evidences on which their opinions were based, it must be admitted, were imperfect; but the conclusions of so many close clinical observers are not without their weight in this matter. Most of the recent writers give the condition recognition, but their statements are brief and in no way convincing. Einhorn¹⁴ makes the positive statement that a benign cirrhosis of the stomach does occur. Osler¹⁵ recognizes the condition and reports one characteristic case. Hemmeter¹⁶ states that the pylorus may be the seat of a hypertrophic stenosis, and that in rare instances the entire stomach may be involved in the hypertrophic process. Leith⁷ recognizes the condition and discusses it at some length.

On the other hand, there are many who doubt the occurrence of a benign diffuse cirrhosis of the stomach. Most German writers believe that all of these cases are carcinomatous. Bret and Paviot¹⁷ share the same opinion with the Germans. They state that their conclusions are based on the condition of the perigastric glands in their cases. They admit that no evidence of carcinoma was found in the stomach-walls themselves, but in the same case the lymphatic glands showed cancerous involvement. Their report is incomplete: and, although one is led to believe that they have made several examinations, only one case is reported. G. B. Hunt is another who argues against the occurrence of a benign diffuse cirrhosis of the stomach. He holds that all cases of diffuse thickening and contraction of the organ are malignant. He offers no proof in support of his opinion except that he has observed one case of diffuse carcinoma of the stomach.

The fact that the patient I have treated has remained well three and one-half years after the operation was performed, strongly suggests that the process involving this markedly contracted, thickened and indurated stomach, was not carcinomatous.

The cause of the symptoms and the mechanism of relief in this case would seem to be as follows: The long-standing,

and progressive, gastric symptoms were dependent upon the changes in the stomach-walls and the gradual narrowing of the pyloric orifice. The pain and excessive vomiting, after the taking of solids or even liquids, that occurred so constantly during the few months preceding the operation, were due to the condition of the pylorus which was almost, if not quite, closed. Starvation would account for the patient's serious general condition.

The gastro-enterostomy permitted food to pass from the stomach to the intestine, affording a means of nourishing the patient. I cannot think that this stomach, on account of the condition of its walls and mucosa, aids materially, either chemically or mechanically, in nourishing the patient.

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RUPTURE OF THE INTESTINE.*

REPORT OF TWO CASES.

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FROM a recent contribution on this subject by Campbell,¹ of Montreal, it appears that up to 1890 the number of cases of intestinal rupture which had been treated surgically was very small as far as literature could show, and of such as have thus been treated few if any reported recoveries are to be found. Since that time, however, a fairly good number of operations for this condition has been reported and of this number a few recovered. For the period from 1894 to 1904 Campbell's search shows twelve recoveries reported in English and American literature, eleven in French and nine in German. As to the percentage of recoveries following operation, the figures given vary with different reporters, from nine per cent. by Campbell to forty-two by Gage.

Speaking generally this condition is not frequent. Out of about 1,300 surgical admissions of the Montreal General Hospital, covering a period of ten years, and representing a large emergency service, there were only eight cases of intestinal rupture. My own experience, the basis of this report, would lead me to believe that this form of injury is rather frequent in localities where there are extensive public works of a character to expose the men to accidents in which traumatism by squeezing frequently occurs. The lumbering and coal-mining industries of this state probably produce a large number of these cases. In a little less than five months two cases of this kind came under my care.

* Read before the West Virginia State Medical Association, June 22, 1906.

¹ ANNALS OF SURGERY, Nov., 1905.

CASE I.—H. S., aged twenty-five, a native of West Virginia, brakeman on a log train. November 16, at 5 o'clock P.M., was engaged in unloading a carload of logs which stood at the upper end of the log-dock and directing them into the pond at the lower end of it, when one of the logs became unmanageable and threatened to land upon him. To escape it he jumped from the log-dock, aiming to land on a pile of logs floating in the pond below. This he missed and instead landed into the pond right against this pile of logs. At the same instant the log from which he was trying to escape reached him with great force, striking him in the back and driving him against the logs in front of him. This log came down from a height of about twenty feet. He managed to disengage himself from between the logs and walked to the edge of the pond, a distance of about six feet, where he was pulled out by his fellow-workmen. On attempting then to walk he fell and complained of severe pain in the abdomen. He was placed in the car of a train which happened to pass by just then and transported to the Davis Memorial Hospital, about forty miles distant. The physician who accompanied him gave him one-half grain of morphine hypodermically while in transportation.

He reached the hospital at about 7.30 P.M. An examination showed the entire absence of any mark of external injury. The abdomen was not distended and the area of liver dulness was normal. There was some dulness in the hypogastric region. The abdominal wall was extremely rigid and he complained bitterly of intense pain all over the abdomen. The urine was free from blood. The passage of a rectal tube gave no result. There was no vomiting. Facial expression was that of great suffering. Temperature about normal; pulse 104 and of good quality. He was placed on the operating-table at 10 P.M. A median incision through the umbilical region showed the following:

The omentum was torn longitudinally in two for its entire lower half. The small intestine, probably about its middle, was torn completely in two. The mesentery for about six inches was torn away from the lowermost end of the ileum. The inner layer of the mesocæcum was torn off the cæcum, and the meso-appendix was torn off the appendix except at its very tip. There was a good deal of blood in the abdomen and pelvis, and active bleeding from the mesentery was still going on. The

amount of fecal escape was small, being limited to a slight soiling of the immediate vicinity of the torn knuckle of intestine.

The ends of the ruptured gut were approximated by a Murphy button and reinforced by a Lembert suture of silk. The omentum was repaired and the mesenteric folds were sutured back onto a narrow frill of the same which remained attached to the ileum and cæcum. The appendix and its mesentery were removed. All bleeding was stopped and the abdomen freely flushed with salt solution. A large glass drain was placed in the pelvis and the greater part of the wound was closed. The shock during and for some hours following the operation was great, necessitating intravenous infusions and the other usual measures. When returned to his bed at about 12.30 his pulse rate was 166 and respirations 54.

November 17, at 6 A.M., within seven hours after the completion of the operation, he passed some flatus spontaneously. At 9 A.M., temperature 99.6, pulse 126 and respiration 28.

November 19, at 9 A.M., temperature 100, pulse 100 and respiration 24. At 12, that is thirty-six hours after the operation, he had a small bowel movement of fecal matter following an enema.

November 20, temperature 98.6, pulse 80 and respiration 24.

November 22. As there was nothing but clear serum found in the drain it was removed on that day and the wound entirely closed.

From this time on his complete recovery was uninterrupted and the outside wound closed by first intention. After a sharp diarrhœa of twelve hours duration he passed out the button on December 26 last, that is on the forty-first day. He has remained well and has been at work since.

CASE II.—W. M. G., aged twenty-nine, a native of West Virginia, teamster. April 12th last, at 2 P.M., while following on the lower side of a hill alongside of several logs dragged by his team, one of the logs rolled down on him, striking him over the left gluteal region and driving him against a stump, the latter impinging against his left iliac region. He was admitted to the Davis Memorial Hospital at about 7.30 P.M. I have not been able to learn whether morphine was given him before his admission, but in all probability this was the case. A very superficial skin abrasion was found over his left hip. There was no

marked distention of the abdomen. The area of liver dulness was reduced to about one-half. Urine free from blood. The passage of a rectal tube gave no escape to feces or flatus, but on removing it the end was found soiled with some mucus and blood. The abdominal wall was rigid but not extremely so. Pain was present but not to an extreme degree; no vomiting. Temperature 100.4, pulse 80 and respiration 20. At 12 midnight the temperature was 99.4, pulse 76 and respiration 32. By that time his pain increased considerably and the rigidity of the abdominal wall became extreme.

He was placed on the operating-table at midnight. On opening the abdomen considerable gas escaped and the peritoneal cavity was found full of intestinal contents. A tear about large enough to admit the little finger was found in the ileum, probably about six feet from the cæcum. There was no other structural damage and no blood. A general and advanced peritonitis was present. The tear was closed with a purse-string suture and the abdominal cavity freely flushed out with salt solution. The removal of a large number of tomato-seeds was particularly troublesome, necessitating some evisceration. Drainage was provided as in the preceding case. At 1.30 of the next day he passed flatus, but died at 6 P.M. from peritonitis.

There are several points which seem to me of particular interest in these cases. It is accepted as generally true that when a rupture of intestine takes place it does so in such portions of it where its mobility is restricted on account of a short mesentery. In Case I the rupture took place at a point where the intestine is usually quite mobile and in this case the mesentery at this point was abnormally long, affording great ease in isolating it from the rest of the gut while making the anastomosis. On the other hand as far as the tearing of the mesentery is concerned it followed the rule. The tearing of the omentum is unusual. Although much more extensively injured than Case II, recovery followed. There were two factors in this case which are to be credited with much for the result. One, the fact that circumstances favored an early operation, and the other the fact that the injury occurred four

or five hours after a meal, that is, at a time when the alimentary tube is the least filled. The suturing back of the mesentery to the narrow frill which was left attached to the gut gave me some misgivings at the time, fearing that the circulation would not be restored sufficiently to keep the corresponding portions of gut from dying, and more especially in reference to the ileum. By the time this part of the operation was reached the patient's condition was such as to make a resection out of the question, and I took chances on a procedure which some may possibly be disposed to consider as objectionable. The amount of damage in Case II was very much less and yet it resulted in an early death. The occurrence of the injury close to a meal and the delay in bringing him to the hospital were no doubt the main factors in producing the fatal issue in this case.

Were I asked what particular symptoms are to guide one in the diagnosis of such conditions, I would emphasize rigidity and pain. Given a case in which an injury to the abdomen occurred which is *liable* to produce rupture of the intestine, and the abdominal wall is found rigid and the patient is suffering from pain in that region, one should not hesitate to operate even in the absence of all other symptoms. In these two cases the absence of any result following the passage of the rectal tube lent some strength to the diagnosis at the time. However, in the case of a large typhoid perforation I have seen a large stool to follow a simple enema.

REPORT OF A CASE OF INTUSSUSCEPTION SUBJECTED TO OPERATION.

COLON OPENED AND PART OF INTUSSUSCEPTUM EXCISED; ENTEROSTOMY FOR
FECAL DRAINAGE; LATER EXCISION OF SEGMENT OF SMALL INTESTINE
AND ENTERORRHAPHY FOR SUPPRESSION OF FECAL FISTULA; ULTIMATE
COMPLETE RECOVERY.

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AND

JAMES B. BULLITT, M.D.,

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THE unfavorable general conditions of this case, together with the extent of surgery involved, make it worthy of record.

G. S., male, eight years of age, was in rather poor health through the winter of 1905-6, but made no special complaint up to April 1, 1906. At this time the glands on the left side of neck below the ear became swollen; there was headache and fever up to 103° F. At this time the mother noticed that urine was scanty and "like black coffee." After about two weeks the swollen glands subsided, and about this time he began to complain of pain in the abdomen, cramp-like in character, and recurring about every fifteen minutes. He vomited in the beginning of the attack of pain, but this soon ceased and did not recur. Bowels were inclined to be constipated during the sickness after April 1; after cramps began, movements could be had in response to enemata but were always small and contained mucus and occasionally small amounts of blood.

After five days of cramps the child was brought to hospital in Louisville where he was first seen by reporters. At this time his general condition seemed fairly good. He looked well, except for the evident suffering on the recurrence of the cramp-like pain. A tumor about the size of an adult kidney could be plainly felt beneath the border of the ribs in the nipple line on the left side. A peculiarity of this tumor was that it would change its position, sometimes being found lower down in the abdomen

below the line of the umbilicus, sometimes higher up just below the costal border, but always remaining on the left side. Having the hand placed on the tumor at the time the pain would come on, the hardening of the intestine beneath the hand could be distinctly felt, very much like the hardening of the uterus with a labor pain. Temperature at this time was 102° F.

Examination of the urine showed evidence of an acute nephritis—quantities of red blood-cells and epithelial casts. In view of this condition, and the fact that the condition had already existed five days, and the further fact that the child's condition was not of a nature to demand instant interference, he was kept under observation in the hospital for nine days, during which time his general condition steadily improved and the signs of nephritis gradually diminished. The tumor and the cramp-like pains were still present, but the latter came at longer intervals and were less severe. The bowels continued to respond to the enema, the stools appearing about normal. At the end of nine days (fourteen days from beginning of abdominal symptoms) the patient was permitted to leave the hospital and go to the home of a relative in the city. Temperature was normal. Here he remained thirteen days, when suddenly the abdominal pain became excessive, vomiting recurred and persisted. Before he could reach the hospital he had a number of convulsions and appeared to be almost *in extremis*. Operation was at once undertaken under ether anæsthesia. Vomitus ejected on operating-table was fecal in odor.

An incision was made in the left linea semilunaris, over the site of the tumor, which was immediately apparent within the lumen of the descending colon. The colon was incised for about three inches, exposing the intussusceptum, which was drawn out and excised, the tumor mass being about six inches in length. The bleeding mesenteric vessels were caught in sutures and tied, and a running stitch united the cut colon to the ileum. The stump was allowed to drop back into the lumen of the colon and the longitudinal incision into the descending colon was closed by continuous suture.

As it was certain that the excision was at a point several inches removed from where the intussusceptum entered the intussusciens, it was deemed advisable to draw a presenting coil

of the distended small intestine into the lower angle of the wound, fix it there, and open it as the concluding step of the operation. We are inclined to believe that the immediate relief so afforded was the determining factor in the child's recovery, and that without it he would have speedily succumbed.

It has frequently been observed that the swelling at a point of constriction is encouraged by the hammering from above of the fecal mass, and that such swelling speedily subsides if relieved of the fecal burden.

No effort was made to reach the point where the intussusceptum entered the intussusciens, where amputation would preferably have been made. The extremity of the child's condition was such that only the more accessible portion of the tumor was removed, several inches of the invagination certainly remaining behind. It would have been better had the incision been made in the median line.

The child reacted surprisingly well from the operation. The discharge from the fistula was profuse. At the end of five days, there being evidences of infection of the wound margins, the stitches were removed, whereupon the wound edges separated widely, both surfaces showing a purulent infiltration. It was necessary to pack and strap the wound to prevent the prolapse of the intestines. Fortunately the intestine was already adherent to the peritoneum at the margin of the wound. The wound gradually cleaned out and healed up satisfactorily, only the fistulous opening in the small intestine remaining. As the subsequent events proved, the fistula was established high up in the course of the small intestine. The bowel drainage excoriated the skin and kept it raw, to the great suffering of the child.

Within a few minutes after the ingestion of food, a thin, acrid discharge would begin from the fistula, and oftentimes particles of food would be discharged within ten minutes of the time they were swallowed, and practically unchanged.

The bowels moved on the day after the operation, the stool consisting chiefly of dark blood, evidently from the seat of amputation. Thereafter bowel movements occurred, gradually establishing regularity and being normal in appearance.

June 23.—The boy's general condition is fair; he has taken on some weight since the operation, but has apparently reached

a standstill on account of the continual losses through the fistula. The bowels are moving every day, dark, soft, natural in character. Following the operation for two or three weeks a cramp-like pain was complained of every now and then beneath the right costal margin, evidently at the point of resection where some constriction remained. For two weeks there has been no pain except the burning occasioned by the fluid escaping from the fistula. Urine is normal—no albumen, no blood, no casts. Appetite is good, but child fears to take food because it sets up immediately a profuse discharge, with excessive discomfort from the accompanying burning.

Operation is to-day undertaken to close the fistula. On attempting to separate the small intestines from the abdominal wall, the adhesions are found very dense and the intestine is torn in several places, rendering it so ragged that a resection of about four inches has to be made, with end-to-end anastomosis by suture.

After this operation convalescence was uneventful. The boy returned to his home and is reported in excellent condition, appetite, digestion and defecation being normal.

It would seem possible that a danger for the future still exists, that being the possibility of contraction at the point of excision of the intussusceptum, with consequent interference with the onflow of the fecal mass. This danger is minimized by the fact that at the point of this possible constriction the fecal matter is always fluid in character and hence little liable to stagnation because of the reduced size of the intestinal calibre.

Examination of the specimen shows the intussusception to have been of the most usual variety, the ileocæcal, the apex of the tumor being formed by the ileocæcal valve. The several peritoneal coats of the bowel which lay in contact are fused completely.

In about three weeks after the beginning of the glandular swelling in the neck, distinct desquamation occurred. It seems practically certain that the desquamation, the nephritis, and the swollen neck glands, were all symptoms of scarlatina.

ANGULATION AT THE SIGMOID.

BY G. PAUL LAROQUE, M.D.,

OF RICHMOND, VA.

THIS condition, to which attention was recently called by Dr. H. Beekman Delatour, in the *ANNALS OF SURGERY* (Nov. 1905), while perhaps more common than is generally supposed is yet sufficiently rare to justify a more or less detailed report of every case observed. The following case is worthy of being placed on record since the condition was recognized and remedied at operation, since which the patient has been absolutely free from symptoms. The woman was a patient of Dr. Stuart McGuire at St. Luke's Hospital, through whose courtesy I was enabled to study the case and to whom I am indebted for the privilege of this report.

Miss Y. About four years ago, at the time of her graduation from school, she had a mild attack of dysentery confining her to bed a few days. She has always led an active life and was always remarkably healthy. She has taught school about four or five years.

In the latter part of the fall of 1902 while visiting away from home, was seized one evening while dancing by an attack of severe colicky abdominal pain, nausea and vomiting, so that she had to give up dancing. This pain was attributed at the time to dietetic error and the next day she was comfortable except for general abdominal soreness. Within the course of a few days she was tolerably well, however, except for marked constipation. During the winter there were occasional recurrences of such paroxysms and constipation became so marked as to necessitate purges.

From March 17, 1903, she suffered for about a month with paroxysms of intermittent violent pain of the type of intestinal colic, attended by nausea, obstinate vomiting, marked constipation, great abdominal distention, and with it all she was completely prostrated. She was operated upon at her home for

intestinal obstruction. Upon opening the abdomen no obstruction was found, but the appendix, slightly adherent, was removed. During convalescence from the operation, the distention and other symptoms persisted, and constipation was absolute for seven days. Upon getting up she noticed persistent abdominal distention. Her physician treated her almost continuously, especially for constipation, and was forced to administer enormous doses of strong purgatives. Licorice powder would generally be fairly effectual.

The distention persisted, constipation has become more marked, and she has frequently suffered violent acute paroxysms of pain, nausea, vomiting and prostration.

In January, 1904, not having improved, she was operated upon again and her uterus, slightly retro-displaced, was suspended, with no effect on the symptoms.

She has continued to suffer recurrent paroxysms of violent pain, vomiting and prostration; abdominal distention has persisted and she has not had a proper evacuation of the bowels in "three years." She has had to continue taking purges and enemata and came to St. Luke's Hospital for treatment.

Collateral facts elicited in the history were of diagnostic value. She has frequently noticed the passage of a little blood by the bowels and on two or three occasions this amounted to a "couple of tablespoonfuls" of dark and clotted blood; she has noticed none of this during the past six months. The evacuations have been made up largely of mucus, at times in very marked quantities and in large flakes, especially in the second and third enemata. Purgues produce violent increase of pain; enemata and the passage of rectal tubes are agonizing. There is never the slightest evacuation nor desire for such spontaneously; frequently two or three enemata are required and these are only partially successful. There has never been a formed movement.

On one or two occasions she has had pain of similar type but having the location and radiation of right sided renal colic. Her physician has found leucocytes, red cells and small quantities of albumen in her urine.

For the past year she has had dysmenorrhea, and purgation occasionally precipitates menstruation.

She is otherwise well and hopeful. She has had no fever nor

chill nor been unconscious, though during the pain she is violently prostrated. There have been no crying paroxysms, convulsions nor stupor.

Upon admission to St. Luke's Hospital she was suffering a violent attack with great distention, rapid pulse, and other signs of a moderate degree of shock. After several days and repeated efforts, a partial evacuation from the lower bowel was secured. Sometime later during the course of vaginal examination the rectum was found impacted with fæces. Examination of the pelvic organs was negative. During the first two or three days of June, 1906, she suffered again a violent paroxysm similar in character to the above; a week later, after sigmoidoscopic examination, another attack, and the following day after cathartic pills a most violent one. The abdomen was markedly distended all over and there was a transverse constriction at the waist line, *i.e.*, just above the umbilicus. Respiratory mobility is unimpaired. Measurements are as follows: at the xiphoid cartilage, 30 inches; half-way between xiphoid and umbilicus, $28\frac{3}{4}$ inches; at the umbilicus $29\frac{1}{4}$ inches; half-way between the umbilicus and the pubis $32\frac{1}{2}$ inches. There is some lordosis in the lumbar region, but this is due to prominence of the buttocks rather than to any spinal curvature. There is slight general abdominal tenderness, somewhat more marked on the right side. Nearly the whole of the colon is palpable, but none of the other abdominal organs can be felt. The abdominal rigidity is that only of distension. Percussion notes a general tympany and diminished area of liver dulness; the splenic area cannot be outlined. There is no area of circumscribed dulness. Auscultation elicits slightly exaggerated sounds incident to peristalsis. Auscultatory percussion is entirely negative.

At this point a provisional diagnosis of incomplete intestinal obstruction was based on the following: (1) A history of recurrent attacks of violent abdominal pain attended with nausea, vomiting and moderate shock (prostration) and a number of times followed by the passage of blood; (2) obstinate, almost absolute, constipation; (3) intestinal distention; (4) hypertrophy of the colon.

Rectal Examination: Externally no sign of disease is seen. Marked pulsation of the hemorrhoidal arteries is noted and

the rectum is empty. The passage of a proctoscope is attended by agonizing pain in spite of the previous administration through the rectal tube of a pint of olive oil. There is an area about eight inches from the external sphincter in which there is greatly exaggerated tenderness and distinct resistance, though this is finally overcome and the instrument passed sixteen inches into the bowel. Inspection notes an apparently sessile growth projecting into the lumen of the canal just above the junction of the sigmoid and the rectum. The mucous membrane of the rectum is moderately red but shows no signs of localized disease and is empty. The sigmoid contains a small quantity of fecal matter and its mucous membrane is thrown into folds and hypertrophied. There are no ulcers and only moderate inflammation. There are no signs of hemorrhoids, fistula, nor fissure. The examination was agonizing to her though she bore it bravely. The colic and local pain persisted until 4 o'clock in the afternoon at which time it was relieved by $\frac{1}{12}$ gr. morphine administered hypodermically.

Cœliotomy was performed June 11, 1906, by Dr. McGuire. The large intestine was distended with gas and fæces; the rectum was empty. A careful search was made of the entire intestinal canal. The sigmoid was found attached by a very short mesosigmoid, causing rather sharp angulation. The colon above this point was filled with fecal matter and the rectum empty. After dividing the short mesosigmoid the fæces were easily manipulated into the rectum. Continuing the examination there was noted some adhesion of the omentum about the stomach. From the sense of touch it was impossible to find any lesion of the mucous membrane.

What had seemed to be a growth arising from the mucous membrane, as seen through the sigmoidoscope, proved to be an invaginated portion of the mucous membrane of the sigmoid flexure through the portion constricted by its short mesenteric attachment, and causing angulation of this part of the gut.

The uterus was held anteriorly by an artificial ligament about an inch long, resulting from a previous ventro-suspension. The old scar was dissected out and the abdominal wall united in layers.

Convalescence was uninterrupted and on the third day following operation a painless bowel evacuation was secured by the

administration of two drams of extract of cascara followed by a simple enema. At the present time she is entirely free from symptoms.

I believe that the condition of angulation should be recognized in the future since the subject has been so admirably described by Dr. Delatour.

Since Dr. Emil Reis called attention in the *ANNALS OF SURGERY* (Oct. 1904) to mesosigmoiditis in its relation to recurrent volvulus of the sigmoid flexure, it would be interesting to know how much causative effect can be attributed in this case of angulation, to the previous attack of dysentery. Since this affection, when it attacks the sigmoid flexure, may be, and frequently is attended by inflammation of the mesosigmoid, it is logical to believe that the contraction of such inflammatory tissue after recovery might easily produce shortening of the mesosigmoid. Could this have been the case in the patient whose record is here reported?

HERNIA INTO THE ILEOCOLIC FOSSA.

BY EDWARD REGINALD SECORD, M.D., C.M.,

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THE ileocolic fossa has been variously designated as the anterior vascular fossa, the fossa of Luschka, the superior ileocæcal fossa, the recessus ileocæcalis anterior, and the anterior ileocæcal, or preileal fossa.

It is described by Moynihan¹ as a narrow fossa or chink, situated between the anterior vascular, or ileocolic fold in front; and the enteric mesentery, ileum, and a small portion of the upper and inner part of the cæcum, behind.

In the Arris and Gale lectures for 1899 Moynihan states that so far as he is aware there are no cases on record which can be considered as hernia protrusions into the ileocolic fossa; that it is only of anatomic interest, and has no pathology. In a fairly comprehensive survey of the literature published since that date I have been unable to discover any report of such occurrence, and I have therefore concluded that the following case was of such rarity and interest as well might merit its being briefly described.

It is that of a frank, distinct, and undoubted hernia of the cæcum, appendix, and about four inches each of the terminal ileum and ascending colon, into the ileocolic fossa; with strangulation and obstruction caused by the anterior vascular fold; laparotomy being performed, the obstruction being relieved, and recovery finally ensuing.

J. T., aged forty, white, laborer, previously healthy, was seen by me in consultation with Dr. Bier, of Brantford, on October 7, 1905. He then presented the following conditions: Recurring

¹ On Retro-Peritoneal Hernia, by B. G. A. Moynihan, M.S. (Lond.), F.R.C.S. (Eng.).

abdominal pain, obstinate constipation, retching, and some vomiting.

History.—The patient had been well and worked at his occupation until two days before, when the abdominal pain began, of a spasmodic cramp nature, recurring in character, and rather increasing in severity. The first night the bowels had not moved, castor oil had been given, but ineffectually, and finally an enema had brought away some hardened fecal masses, but no gas, and

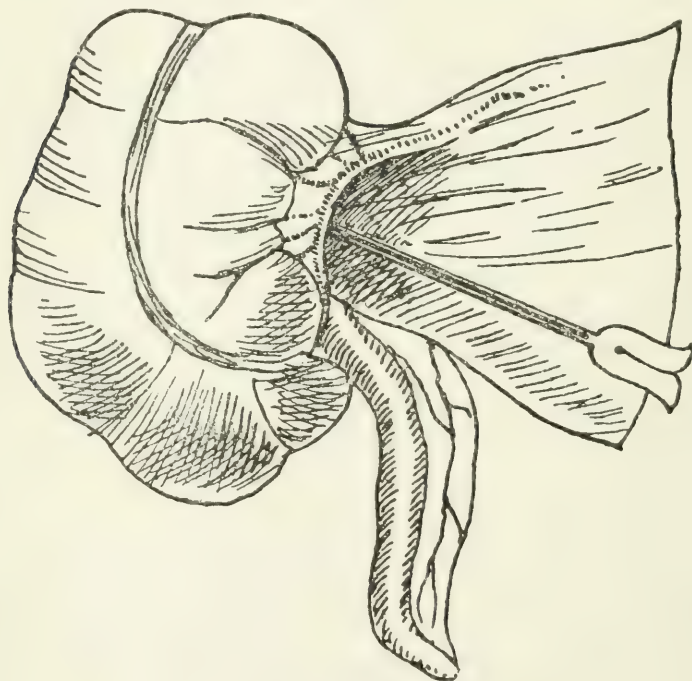


FIG. 1.—Hernia into the ileocolic fossa.

had produced no alleviation of the pain. The second day he had vomited once, and had shown a tendency to increasing pulse rate. He was removed to the John H. Stratford Hospital, where I saw him.

He was a healthy-looking man of about forty, with an expression somewhat worried or drawn, but not typically hippocratic. Temperature $98\frac{2}{5}$. Pulse 100. Respiration 16.

His abdomen was slightly distended, especially on the right

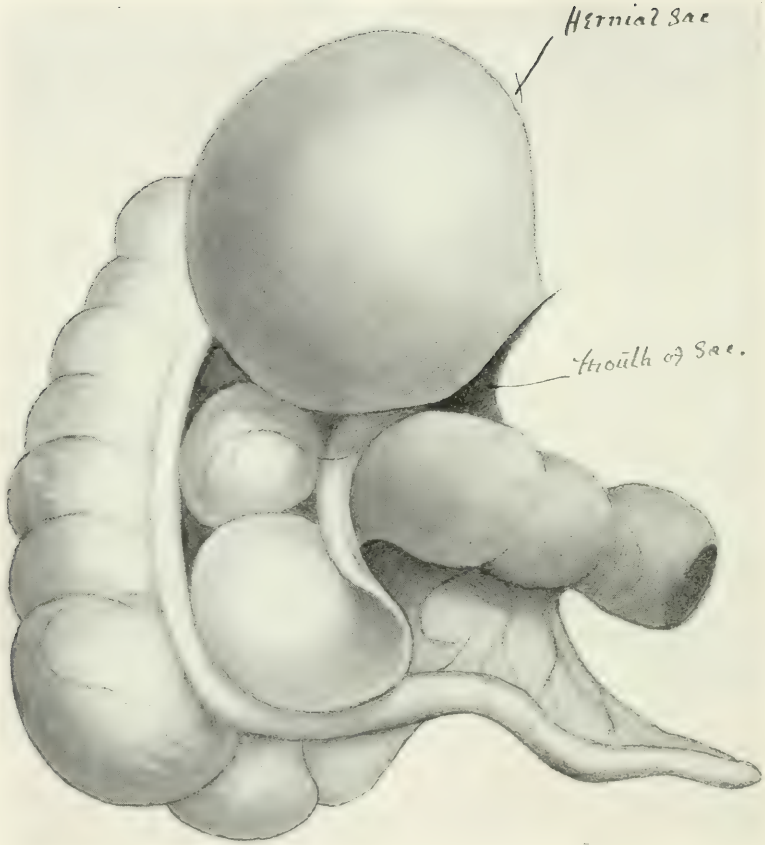


FIG. 2.—Hernia into the ileocolic fossa.

side. There was no board-like rigidity, but a feeling of resistance over the right rectus muscle, and general tenderness over the whole right lower quadrant. On observing the abdomen for a few moments, it was distinctly noticed that with the onset of the pain an elevation or tumor became evident below and to the right of the umbilicus. It was, roughly speaking, rounded in outline, and about the size of an orange. This elevation was evident not only to inspection, but also to palpation. It was doughy, tender, tympanitic, and localized in the one position, that is, it did not travel along the bowel as a peristaltic wave. Usually a distinct gurgling was heard during the acme of the pain.

Operation.—The abdomen was opened by an oblique incision over the appendix region. What appeared to be the distended and markedly-congested cæcum and colon appeared in the wound, which former, however, on closer examination showed themselves to be covered by an additional layer of peritoneum; the parietal peritoneum had of course already been well opened. This additional layer of peritoneum was quite thin, fairly transparent, and easily movable over the subjacent bowel. External to this mass was another loop of what appeared to be colon. Following this latter loop upward it appeared to be continuous with the ascending colon, but on following it downward to the appendix region no caput coli nor appendix could be discovered; and on searching more inwardly a taut band was found running in an oblique direction downward and outward from the root of the mesentery, roughly, in a direction toward the anterior superior spine (Fig. 2). The colon bulging out from beneath this band was without the additional layer of peritoneum noticed above and on slight traction being made on this loop of colon it slipped out from beneath the band, followed by the cæcum with the appendix, and the terminal four inches of the ileum. These portions of the bowel were all distended and markedly congested, and in one area on the outer surface of the cæcum the bowel-wall was ecchymotic, and in the centre of this a small whitish slough was situated. This slough was looked for and found, since on withdrawing the bowel from under the above mentioned band, a fecal odor had immediately become noticeable.

The pouch of peritoneum left by the withdrawal of its contained intestines was shaped much like a rubber tobacco-pouch,

with its mouth about an inch and a-half across, pointing in a downward and inward direction. When filled the size of the pouch would be somewhat greater than that of the folded fist.

The mouth of the pouch was closed by a single row of catgut, attaching the taut anterior fold to the anterior layer of the mesentery of the lower end of the ileum.

The patient's condition not justifying any attempts at resection, I sewed the parietal peritoneum to the cæcum round the gangrenous area, and opened the bowel at the situation of the slough.

The fecal fistula thus established, discharged practically the whole fecal excreta for a time, but gradually closed down by cicatrization, until at the end of November a small fistula remained, discharging only when the bowel contents were unusually fluid. At this stage nature's efforts at a cure seemed to become exhausted. The fistula remained practically stationary for the next month.

At the first of the year I therefore opened up the fistulous tract down to the cæcum, closed the opening in the latter by inverting the edges and placing two rows of catgut sutures, bringing together the opposed peritoneal surfaces. The different layers of muscles were dissected out from the scar tissue, and carefully approximated, and the skin incision closed by silk-worm gut. Aside from some slight skin infection, the healing process was perfect, and the patient was discharged three weeks afterwards.

He has remained entirely well from then to the present date.

TRANS-URETERO-URETERAL ANASTOMOSIS.

I—INTRAPERITONEAL. II—RETROPERITONEAL. (a) ANTERIOR TO AORTA AND VENA CAVA; (b) POSTERIOR TO AORTA AND VENA CAVA.

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I. *History of Ureteral Anastomosis*.—One of the earliest operations, if not actually the pioneer case of ureteral anastomosis, was made by Simon, of St. Thomas' Hospital, London, in 1851, in an effort to extraperitoneally anastomose the ureters into the rectum. Nussbaum followed the method of Simon in 1876; also Smith in 1879. Most of the early attempts were made for the relief of vesical extrophy. Gluck and Zeller were among the early experimenters on animals. In 1886 Schopf,^{23 24} a German, and Poggi,³⁹ an Italian, within a few days of each other performed an end-to-end anastomosis, though by different methods. Much experimentation on animals now developed in the years following this notable advance. Budinger in 1896 endeavored, on animals, to duplicate previous work, but with fatal results. Tizzoni and Poggi removed the entire bladder; a new receptacle was formed from an intestinal loop, and the ureters were implanted therein. In 1892 the technique of Van Hook was published. In 1897 Bovée, in reporting a personal case, collected 12 cases of ureteral anastomosis from the literature, two of which must however be discarded. He materially modified the method of Van Hook. The following method classification of uretero-ureteral anastomosis, together with exponents of each method, tabulated by Markoe and Wood²⁵ is excellent:

I. Transverse end-to-end. { (a) Without support. Schopf, Hoch-
enegg, Cushing.
(b) With support, Tauffer.

II. Oblique end-to-end. Bovée.

- III. Invagination. { (a) Without support. (1) Ureter not split.
Poggi.
(2) Ureter split to invaginate. Mayo Rob-
son, Winslow.
(b) With support. Markoe.

IV. Lateral implantation. Van Hook, Kelly, Emmett, Doherty.

No inconsiderable ingenuity has been displayed in the effort to overcome the hiatus caused by an excessive loss of ureteral substance. Thus Bovée,²⁶ based upon successful experimental work on two dogs, advises dislocation of the kidney downward, with suturing in its new bed subsequent to the completed anastomosis. Monari believes that the ureter may be attached to the abdominal wall under considerable tension, and when time has produced the required length, a lateral anastomosis may be attempted. Rydygier suggests implanting the severed ends on the abdominal wall and connecting them by a duct lined with skin; while Van Hook would elevate a flap from the bladder, develop a diverticulum and so bridge over the space to the proximal end of the ureter.

At the close of this chapter of ureteral surgery none of these suggestions had been performed on man; and the choice rested between implantation into the bladder, bowel, or skin.

II. *Anatomy of the Ureter.*—For an exhaustive study of the anatomy of the ureter search must be made through various monographs which discuss the theme. The following points will, however, prove germane to the subject in hand, and will be helpful in the final analysis: The adult ureter ranges from 25 to 40 cm. in length, while the outside diameter may be said to be 3 to 4 mm.; yet the fact remains that both the outside diameter and lumen vary considerably owing to curvings and sacculations that are fairly constant. The course of the ureters is not regular nor symmetrical. So far back as 1869 Freund and Joseph²⁷ showed that the left ureter is nearer the mid-line and as a rule nearer the uterus and its cervix. Crossing the common iliacs they are from 5.7 to 7 cm. apart; then following the pelvic curve they separate until



Fig. 1.
Van Hook



Fig. 2.
Robson



Fig. 3.
Mayo Robson + Winslow



Fig. 4.
Tauffer



Fig. 5.
Markoe + Wood



Fig. 6.
Tauffer

Fig. 7.
Markoe + Wood

PLATE I.—Various methods of ureteral anastomosis, with their advocates.*

*Dr. Mills has here portrayed certain steps and the end results of actual anastomoses of the human ureter made by him for this plate. It is probable that, even with the reduction necessary to make a full-page plate of the ANNALS OF SURGERY, the dimensions will remain slightly in excess of the normal ureter.

2 to 3 cm. below the iliacs, from 10 to 13 cm. intervenes; at line of the internal os, 9.8 cm. apart; on entering the bladder, 2.7 to 3.5 cm. apart. The distance between the external os and the right ureter, 2.5 to 3.3 cm.; the left ureter, 1.5 to 2.7 cm. Luschka²⁸ and Holl²⁹ give measurements which vary somewhat from the above, but agree as to the asymmetry ordinarily encountered. Quenu and Duval have suggested as a valuable landmark in identifying the lower ureter the bifurcation of the common iliac artery. The right ureter will be found 1 cm. external to the bifurcation and crosses the iliac vertically, while the left ordinarily is exactly upon the bifurcation. The ureter is composed of three layers. The outer coat is fibrous; the middle coat is muscular, whose thin smooth longitudinal folds manifest some tendency to stratification; the intima is mucous. The muscular coat, inducing a fairly rhythmic peristalsis, is assisted by the force of gravity in establishing the cloacal function of the ureter. Waldeyer³⁰ has directed our attention to the fact that certain longitudinal bundles extend from the bladder out on the ureter. These are united by connective tissue, and separated from the ureter proper by a space which he considers a lymph-space. This sheath ranges from .5 to .75 mm. in thickness, and extends within the ureter from 3 to 4 cm. Disse, however, claims that these bundles do not arise from the bladder, as might be inferred, but from the ureter, and thinks it probable that their hypertrophic condition, together with the subjacent space, follows vesical contractions exerting traction on the outer ureteral coat. There is, in addition to this sheath of Waldeyer, a second fibro-muscular covering which, starting upon this structure and somewhat intimately blending with it, continues upward. Between this sheath and the ureter proper are found fine fibrous fascicles and adipose tissue, which as has been suggested by Sampson may subserve the function of a cushion protecting the ureter. It is a moot point as to whether true lymphatic spaces exist in this tissue. Sampson has also directed attention to the contractile mobility of the ureter within this sheath, its protective influence against inflammatory and malignant extension processes, and that within its

embrace is found the periureteral arterial plexus. The lymphatic system is well developed and found within the different layers. The blood-supply of the ureter is drawn from branches of the renal, spermatic, utero-ovarian, internal iliac, inferior mesenteric, middle hemorrhoidal and inferior vesical arteries; while its veins, with apparently no prevailing rule, empty into neighboring vessels. Disse has shown that the pelvis of the kidney draws its blood-supply from a branch of the renal artery which courses down over the abdominal ureter; this section also derives nourishment from the spermatic. The pelvic section owes its main supply to the middle hemorrhoidal and inferior vesical arteries. In general it may be noted that these trunks parallel the ureter, to which they are attached by connective tissue. From these parallels arise at comparatively frequent intervals branches which, piercing the muscularis, still further divide within the intima into longitudinal sub-branches found fairly constantly from the kidney to the bladder. Capillary systems to the epithelium and muscularis are the terminals of the arteries of the propria. From these systems the venous current is carried through a plexus, largely longitudinal, inside the muscularis. This venous plexus of the intima empties into channels within the adventitia, which parallel the arteries. Probably the most valuable of our anatomic assets of comparatively recent acquisition is the periureteral arterial plexus, whose orientation has been so felicitously accomplished by Sampson.³¹ He has shown that from the aorta, the renal, ovarian, iliac, uterine, etc., arteries arise branches which may be styled uretero-subperitoneal arteries. These arteries ordinarily divide into two branches; first, an ureteral branch which helps to form the periureteral arterial plexus; second, a subperitoneal branch, which supplies the tissue contiguous to the ureter.

1. The ureteral arteries on reaching the ureter divide into ascending and descending branches, both paralleling the ureter and united to it by a loose fibrous tissue; a free anastomosis exists between the ascending and descending sub-branches. Thus, enveloping the ureter, is found a longitudinal arterial system, whose offshoots abundantly anastomose, extending

from the kidney to the bladder. From these large trunks smaller branches arise which imbed themselves somewhat more deeply in the perimuscular fibrous tissue of the ureter than do the stems; and these, too, anastomose, thus forming with the main trunks a periureteral arterial plexus extending the entire length of the ureter up over the pelvis of the kidney and still accompanying the ureter as it pierces the bladder-wall. From this plexus still smaller vessels arise which penetrate the walls of the ureter; and yet other channels are found which, leaving the ureter, supply the adjacent tissues, and even these may anastomose with branches of other vessels supplying these parts.

2. The subperitoneal divisions of the uretero-subperitoneal vessels supply the tissues adjacent to the ureter and also, in places, the peritoneum. These may anastomose with each other and with branches from neighbouring vessels including branches from the ureteral plexus, and thus may serve as a source of nourishment to the ureter. And yet other sources exist; for the uterine and vesical arteries of one side anastomose with those of the other, and in addition there is a free anastomosis between the uterine and ovarian arteries; and again the branches of the latter anastomose with branches from the renal. The periureteral arterial plexus thus is shown to receive its blood-supply from definite ureteral arteries, and may be nourished indirectly through the anastomosis of these arteries and branches from the plexus itself with the branches of vessels supplying the tissue circumjacent to the ureter.

Sampson has also shown that in the dog the ureter will withstand extensive manipulation even to stripping with the finger nail, or freeing throughout its entire length, and no untoward effect will follow provided a sufficient number of nutrient vessels remain intact to preserve the integrity of the ureter. [Of interest at this point is the record of Margarucci³² that he isolated the entire ureter in ten dogs; in none necrosis followed. He, too, explains this fact by the existing arterial supply with its numerous anastomoses. He claims that the supply from the renal artery alone is almost sufficient

to nourish the entire ureter. Durante³³ accomplished the same feat on a woman, where the ureter was involved in a gigantic cystadenoma of the broad ligament.] And on the other hand manipulation which destroys the periureteral arterial plexus even though far less severe than in the former instances, will as a rule, so impair the vitality of the ureter that necrosis will supervene. He concludes that when the integrity of the ureter is impaired, as by malignant invasion, and choice remains, resection with end-to-end anastomosis or a vesical implantation is preferable to any method which demands a stripping so severe as to imperil the function of the periureteral arterial plexus.

III. *Indications for Ureteral Anastomosis.*—The indications for an ureteral anastomosis are sufficiently obvious to justify the omission of special narration and discussion. In brief: 1. Any condition in an operative attack within the abdomino-pelvic area which necessitates an interruption of the continuity of the ureter will demand consideration for the restoration of the integrity of the urinary channel. 2. Operative casualties occurring within the abdomino-pelvic area which seriously impair or destroy the continuity of the ureter. 3. Any pathologic condition existing in the abdomino-pelvic area which so encroaches upon the ureter, whether by extension or pressure, that its function is seriously handicapped or destroyed.

These three classes will be found to include the majority of cases coming under observation. Pathologic conditions associated with calculi, fistulas, etc., are largely of collateral importance. The more commonly employed means for solving the difficulty have been implantation in bowel, bladder, or skin, and uretero-ureteral anastomosis. Nephrectomy of the crippled side should, with justice, be definitely eliminated from the list of restitutional methods, for the impaired ureter is neither restored nor so transferred that its cloacal functionation may continue; and in addition the kidney, which at this point in the patient's career has but a collateral significance, is ablated. As well might one class an amputation following frac-

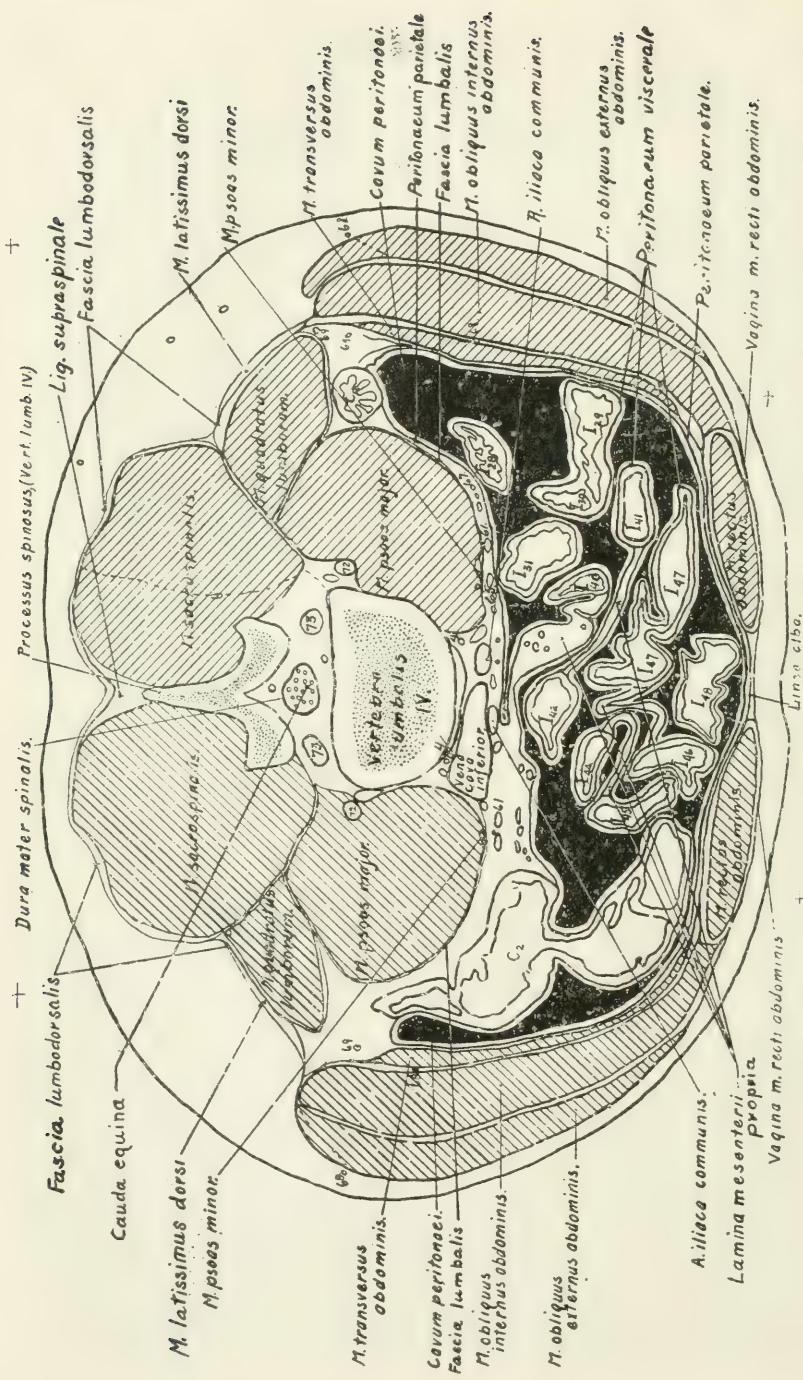


PLATE III.

ture as a restitutorial measure. Ligation of the proximal end of the ureter with induced hydronephrosis and subsequent cessation of nephric function (corroborated by the experimental work of James ⁴⁰) should also be excluded; for while the operative work is obviously less perilous than a primary nephrectomy, the end result is analogous—the patient is deprived of the use of his kidney. But this analogy is not complete, for it is impossible to state the actual effect upon the organism when a kidney is thus abruptly thrown out of functionation and an infection atrium may be found existent at any point between the kidney capsule and the ligature encircling the distal end of its ureter. That the remaining kidney may be seriously crippled,—indeed, absent; that such conditions are all too frequently not ascertained previous to an abdominal operation; that it is most difficult to obtain exact information in the stress of so serious an operative casualty as a cut ureter, when time is priceless, seem to be statements of facts so vitally patent as to demand no further discussion, yet that imperatively indicate restitutorial rather than destructive surgical measures. Of these various restitutorial measures, we are, in this discussion, concerned with but the last,—ureteral anastomosis.

IV. *Methods*.—Consideration of the methods scheduled in Section I. will show that the general plan of procedure does not vary in any vitally essential detail.

In Groups I. and II. apposition of extremities is direct, transverse or oblique, with or without support.

Group III. Apposition of extremities is by direct invagination, with or without splitting of segment, with or without support.

Group IV. Apposition of the extremities by lateral invagination, without support.

In Groups I. and II. Outer, middle and inner coats come into direct contact with their several fellows of the other segment.

In Groups III. and IV. The middle coats do not appose each other, but contact is permitted between the outer sheath

of the male segment and the inner coat of the female, save when the outer sheath of the male segment has perchance been liberally scarified,—it then may be assumed that the muscularis of the male segment would be brought in apposition with the intima of the female. A modified Jobert's invagination suture seems to have been most commonly employed.

V. *Personal Work*.—It may be readily conceived that a lateral spinal deflection would so seriously alter ordinary anatomic relations that any one of these excellent methods would prove technically difficult, if not actually impossible.* And again so large a section of the ureter may be lost, whether as a result of pathologic involvement or surgical intervention, that here also a similar difficulty, or impossibility, would be confronted. With these matters under consideration, and in search of a method that might prove efficacious, in 1900 was devised and performed on two dogs the lateral invagination of the proximal end of one ureter into its fellow. In my "Data of Experiments" this procedure was designated "Intraperitoneal trans-uretero-ureteral anastomosis." The first point to be oriented was, Is the conception an anatomic possibility? the second, Is it a physiologic success? The following notes (heretofore unpublished) show:

Experiment I.—Nov. 26, 1900. A small mongrel cur was anæsthetized, the left ureter, through a median incision, isolated, divided, the lower segment ligatured and dropped, the upper clamped; the right ureter isolated, a suitable longitudinal incision made, a modified Jobert's invagination suture (fine silk) placed in anterior face of proximal extremity of left ureter, the mesentery perforated close to its root and at an appropriate level, and the left ureter drawn through the longitudinal incision of the right, by means of the two suture ends which were then caused to transfix the three coats of the right ureter below the lower angle of the longitudinal

* Cognate to these personal statements are the observations of Bologna (III Cong. Dell' Ass. Nazionale dei Med., 1905). Among widespread changes developed concomitant with, or sequent to, a scoliosis, he notes that the kidney also suffers, the one on the invaded side being sometimes laterally compressed between the vertebral column and the chest-walls, while the kidney on the concave side hypertrophies. The contracted psoas may so close the lumen of the ureter as to develop an hydronephrosis.

incision. This suture was tied, also three others, one inserted at the upper angle formed by the junction of the ureters, and two, to snugly close the incision, above the junction, which had been made a trifle too long. The lines of junction were covered by a fold of mesentery appropriately sutured.

No special postoperative occurrences. The dog lived eighteen hours. Autopsy showed a competent anastomosis, with no leakage nor ballooning of either ureter or kidney pelvis; no evidence of peritonitis. There was urine in the bladder. The mercurial manometer showed that the anastomosis suture lines withstood up to a pressure of 60 mm. of mercury, at which point leakage followed.

Experiment II.—Dec. 13, 1900. A small mongrel dog was anæsthetized and again the proximal end of the left ureter invaginated laterally, through a longitudinal incision, into the right. The technical details of this experiment differed in no essential from those noted in *Experiment I.*, save that no additional sutures were required to close the longitudinal incision, and two additional sutures were inserted laterally at the spread of the longitudinal incision, made by the inserted ureter, in order to more snugly approximate the union. The mesentery was sutured over the anastomosis. The dog lived forty-eight hours. Autopsy showed a competent anastomosis with no leakage, nor ballooning of either ureter or kidney pelvis; no evidence of peritonitis. The bladder contained urine. The mercurial manometer showed that the anastomosis suture lines would withstand up to 50 mm. of mercury, at which point leakage occurred.

These experiments were carried out under adverse conditions, in that facilities were not to hand for suitable postoperative care of the dogs. After consideration of the autopsy findings, of which the essentials have been given, both Dr. Budgett (late Professor of Physiology, Medical Department, Washington University), who most kindly assisted me and to whom my thanks are due, and I were strongly inclined to the belief that death followed in both experiments from these conditions rather than from any factor directly attributable to the operations.

Conclusions.—I. These experiments have proved that an intraperitoneal trans-uretero-ureteral anastomosis is an anatomic possibility.

One dog lived eighteen hours, the other forty-eight hours; within these brief periods union sufficient to withstand up to 60 mm. and 50 mm. (mercurial manometer) respectively had been secured. Neither hydronephrosis nor hydro-ureter was

in evidence. Urine was within the bladder. It would seem, therefore, even within the limitations above noted that

II. An intraperitoneal trans-uretero-ureteral anastomosis is a physiologic success.

These experiments were not recorded in the literature and nothing further was attempted along this line of research until March, 1906, when the following procedures were devised and executed on the cadaver. The reasons for altering the above plan of operative attack were, in brief, that it was apparent that if a technique could be constructed that would more nearly protect the ureter from injury and from involvement with other abdominal structures, and in addition conserve and perchance add to its normal blood-supply, a distinct stride in advance would have been measured. These conclusions were based upon a not more than conventional comprehension of the blood-supply of the ureter. They were, however, confirmed when the masterly exposition of the blood-supply of the ureter by Sampson was given to the surgical world. The technical difficulties of the work, hereinafter described, were greatly augmented by the fact that the cadaver subject was not less than eighteen months old and had undergone several periods of drying and moistening, with the result of both tissue rigidity and brittleness.

Experiment III.—Through the anterior abdominal wall (which had previously been opened in the mid-line) the field was so cleared by laying aside obscuring structures that the courses of the ureters were developed. A suitable longitudinal incision through the peritoneum over the right ureter, and its isolation, above the promontory of the sacrum, were made. Retracting the ureter laterally, a retroperitoneal dissection, largely by the finger, but assisted occasionally by the handle of a scalpel, was made toward the mid-line, penetrating in the layer of connective tissue between the inferior vena cava and aorta posteriorly and the peritoneum anteriorly, until the left ureter was reached and identified. After liberating this for a sufficient distance it was brought across to its fellow, incised, the distal extremity released, and a lateral invagination through a longitudinal incision in the right ureter was made as detailed in Experiments I. and II. When the anastomotic area was released and the peritoneal edges of the longitudinal incision approximated, the entire field of manipulation was found to be wholly retroperitoneal. The difficulty of accomplishment was not excessive, and the ureters showed no evidence of undue tension.

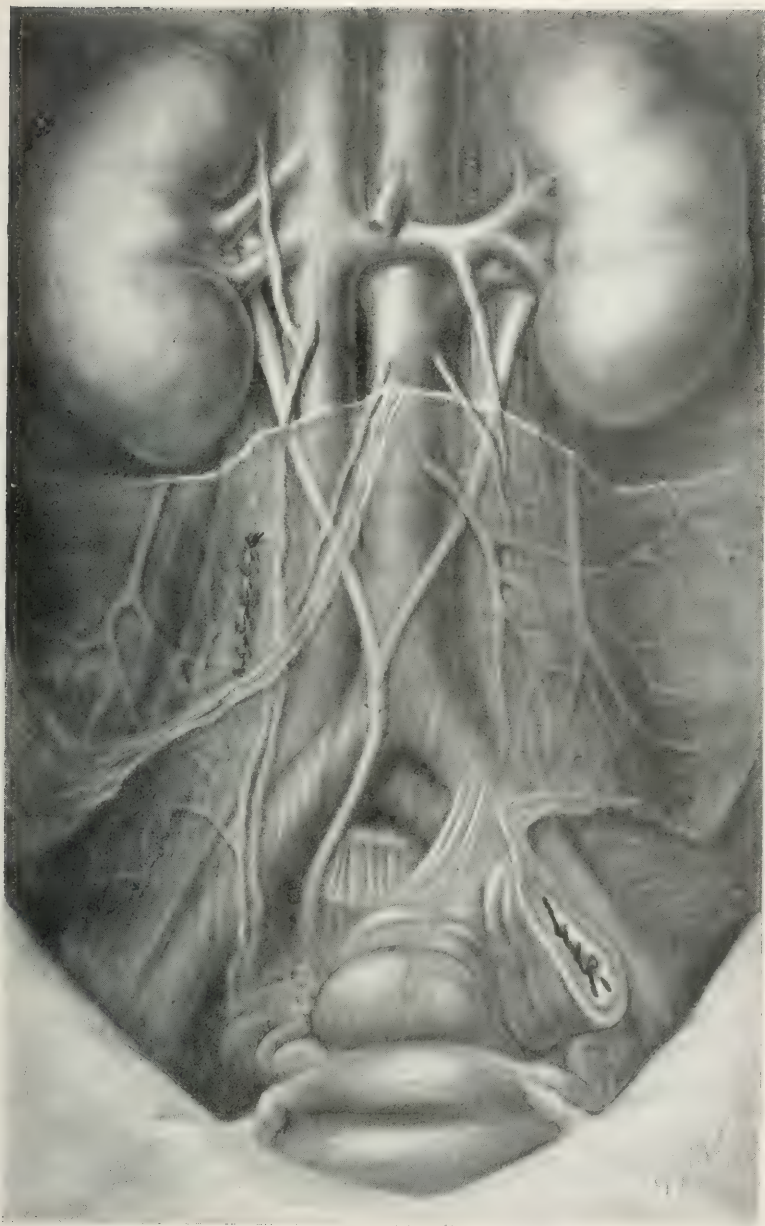


PLATE VI.—Retroperitoneal trans-uretero-ureteral anastomosis. Anterior to aorta and vena cava.

A tendency for the sound ureter to approach the mid-line is to be noted; this is due in part to its new attachment to its fellow, in part to its segmental release from its original bed. The distal stump of the left ureter is not shown. Peritoneum has been removed over the kidney, but portrayed transparent over anastomotic area.



PLATE VII.—Retroperitoneal trans-uretero-ureteral anastomosis. Posterior to aorta and vena cava.

Peritoneum, aorta, and vena cava removed to show ureters and their relation to vertebral column. The distal stump of the right ureter is not shown.

Experiment III. proved that a retroperitoneal trans-uretero-ureteral anastomosis is an anatomic possibility.

Realizing, however, that a more direct route might be available, and that various conditions, such as a lodosis or a relatively extreme depth of the lateral abdominal fossæ, would make such a route highly valuable, the following procedure was performed:

Experiment IV.—The sutures of the above noted anastomosis were liberated and the two ureters replaced in their normal positions. Through the same longitudinal incision over the right ureter a dissection was made toward the mid-line and passing between the vertebral column posteriorly and the vena cava and aorta anteriorly the left ureter was reached and again withdrawn to its fellow, and again invaginated in the existing longitudinal incision by the method followed in the former efforts. When the anastomotic area was released and the peritoneal edges of the longitudinal incision approximated, the entire field of manipulation was found to be wholly retroperitoneal. In this instance, also, the difficulty of accomplishment was not excessive. It was also readily seen that owing to the shorter route traversed the ureters, whose liberated areas had not been extended over those of Experiment III., had gained demonstrable laxity.

While retroperitoneal trans-uretero-ureteral anastomosis, whether anterior or posterior to vena cava and aorta, is admittedly more difficult of accomplishment than intraperitoneal trans-uretero-ureteral anastomosis, yet it must be conceded that owing to the shorter hiatus to be bridged, with proportionately less disturbance of the ureters and their blood-supply, their probable subsequent vitality and power of functionation are enhanced in conformity with the postulates of Sampson. It is also probable that owing to the replacement of the ureters within beds which are closely allied to, if not in fact actually identical with, their normal surroundings, the interference with their blood-supply will be reduced to the minimum; and the possibility of nourishment to be derived from contiguous connective tissue and the peritoneal covering must not be ignored.

Beyond the technical difficulties inherent to such manipulations, and the necessary time involved, possibly superimposed upon other operative measures (both of which may, however,

be diminished by practice), the query which will, in all probability, most readily spring to the mind is, whether or not sufficient pressure will be exerted by the aorta and vena cava to materially interfere with the patency of the transferred ureter (or the anastomotic area itself, if it should happen to be the point in contact). It is conceded that Experiments III. and IV. prove merely the anatomic possibility of a retroperitoneal trans-uretero-ureteral anastomosis, respectively ante-aortic and ante-vertebral. Suitable material has not as yet been secured for demonstrating if these procedures be physiologic successes. But in support of such an hypothesis may be adduced the well-known physiologic fact that a tube with well-defined mural structure which exhibits an intratubular pressure, whether constant, periodic or occasional, is able to maintain its patency though extramural pressure be maintained. The rectum clamped between the sacrum and an augmenting pelvic fibroid is a fairly familiar example; the vena cava and the left common iliac vein fixed between the vertebral column and the aorta and right common iliac artery, is another. These examples are specially interesting, for in the former an intratubular pressure exists only during evacuation of, or when the rectum is filled with, fæces; and in the latter it is known that dependent largely upon intrathoracic conditions the intracavic pressure varies from an actual negative to but a few millimetres of mercury, while the diastolic and systolic aortic pressures presumably somewhat exceed the brachial pressures, which are 75 to 100 and 100 to 150 mm. respectively. In other words, the patency of a compressed tube may remain even though the constricting force be in excess of its own intratubular pressure. The intraureteric pressure reaches 60 mm. of mercury, beyond which an hydro-nephrosis threatens.

While from a purely controversial standpoint it might be inopportune to allude to the increase of ureteric pressure which follows when a constricting force is permitted to exert itself, yet clinically we are compelled to concede that this increase of intratubular pressure but enhances the probability of maintenance of patency.

In the final survey of the literature of ureteral surgery before closing this article, it was discovered that the proceedings of Experiments I. and II. carried out independently by myself in November and December, 1900 (not hitherto recorded), had been in all essentials paralleled by the following workers:

1894. BOARI and CASATI³⁴ tried uretero-ureteral anastomosis on the dog on eight occasions. The mesosigmoid was perforated; approach was gained both by the anterior abdominal route and also a lateral extraperitoneal route, of which close details are lacking. All dogs, save one, died within two or three days after operation. This one died from peritonitis with urinary infiltration on the eighth day. The anastomosis had yielded at one point.

1895. MONARI³⁵ followed the same method on the dog 13 cm. from the bladder. "At the end of a certain time," the dog was killed; stenosis of the ureter at point of penetration of the mesosigmoid found; no stenosis at site of anastomosis; hydro-ureter and ballooning of the kidney pelvis existed. He concludes that the operation may be made in man, in certain cases of urinary fistulas, in place of more serious procedures, and that no danger would follow if the ureter be replaced in "its fatty capsule."

1896. WISSINGER³⁶ presented before the Medical Society of Hamburg "a beautiful specimen," but so far as the literature shows failed to mention either source or method.

1905. FREUND³⁷ records that he implanted, in a bitch, the proximal end of an ureter in a fallopian tube; the other end of the tube was then connected with the bladder. Mention is made that a similar plan was followed by D'Urso and de Fabii. After stating that transureteral anastomosis had been suggested as a possibility by Kelly, McMonagle and Sampson, he describes having cut a ureter in a dog; its central end was drawn by ligatures through the mesentery, and laterally attached by two sutures to its fellow; six silk sutures were utilized in completing a lateral anastomosis.

1905. BERNASGONI and COLUMBINO³⁸ performed uretero-ureteral anastomosis on ten dogs, both near the bladder and in the lumbar region. They believed that they were the first to successfully penetrate the mesentery. They direct attention to the fact that in the dog so loose is the posterior peritoneum that the ureter is furnished with what is practically a mesoureter; this, in particular, holds in the vicinity of the bladder. Eight of their cases were near the bladder, lateral implantation between two retention sutures; continuous sutures were employed, which were covered by a Lembert of the peritoneum. Three dogs died; five perfect results determined at end of three to four months. Two cases were transmesenteric at height of the umbilicus; ureters were found over the psoas, and anastomosis was made by the former method, save that the

mesentery was perforated. The first dog died of peritonitis on eighth day; no leakage noted. The second survived. Autopsy at three months; result excellent.

So far as known the work detailed in Experiments III. and IV. has not been duplicated.*

VI. *Chronology*.—The following chronologic table of the development of the surgery of the ureter outlines in sequence the rather more essential steps that have led up to the present-day work in uretero-ureteral anastomosis. It also includes the latest experimental work, so far as known:

- 1851. *Simon*.—Extraperitoneal uretero-rectal anastomosis.
- 1876. *Nussbaum*.—Extraperitoneal uretero-rectal anastomosis.
- 1879. *Smith*.—Extraperitoneal uretero-rectal anastomosis.
- 1886. *Schopf*.—Transverse, end to end, without support.
- 1886. *Poggi*.—Invagination, end within end, without support.
- 1892. *Van Hook*.—Invagination, lateral, without support.
- 1894. *Boari and Casati*.—Intraperitoneal trans-uretero-ureteral anastomosis,—dog.
- 1895. *Monari*.—Same method,—dog.
- 1897. *Bovée*.—Oblique end to end.
- 1900. *Sharpe* (Nov. and Dec.).—Intraperitoneal trans-uretero-ureteral anastomosis; lateral invagination,—dog.†
- 1905. *Freund*.—Implanted the proximal end of ureter in a Fallopian tube. The other end of tube was then implanted in the bladder. (States that D'Urso and de Fabii had also accomplished the same.) In addition records a lateral intraperitoneal trans-uretero-ureteral anastomosis,—dog.
- 1905. *Bernasconi and Columbino*.—Intraperitoneal trans-uretero-ureteral anastomosis,—dog.

* I desire to acknowledge, with appreciation, the courteous assistance and valuable coöperation, tendered me by Dr. Robert J. Terry and Dr. Vilray P. Blair, respectively Professor of Anatomy and Associate Professor of Anatomy in the Medical Department of Washington University.

† Not hitherto published.

1906. *Sharpe* (March).—Retroperitoneal trans-uretero-ureteral anastomosis, lateral invagination,—cadaver.

(a) Anterior to aorta and vena cava, posterior to peritoneum.

(b) Anterior to vertebral column. Posterior to aorta and vena cava.*

VII. *Conclusions.*—

I. The blood-supply of the ureter is ample, of which probably the peri-ureteral arterial plexus is the most essential factor.

II. Operative procedures which conserve the blood-supply, in particular the peri-ureteral arterial plexus, are ordinarily satisfactory.

*Of very great interest, in connection with the problems incidental to wounded ureters or such other conditions that may tempt the operator to find a solution in a nephrectomy, is the work of Carrel, Floreco and others in organ-transplantation. They have most ingeniously devised and successfully executed plans by which the kidney, heart and other organs, removed from their normal site and transplanted elsewhere, have continued functionation. The three natural subdivisions of auto-transplantation, homo-transplantation and hetero-transplantation—have received consideration and experimental work is of record. This suggestive research is pregnant with possibilities for future development. For details see:

Carrel. La technique opératoire des anastomoses vasculaires et la transplantation des viscères. Lyon Medical, 1902.

Carrel. Les anastomoses vasculaires; leur technique opératoire et leurs indications. **Le Congrès des Médecins de la langue Francaise de l'Amérique du Nord.** Montreal, 1904.

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III. When the integrity of the ureter is impaired, restitutorial rather than destructive surgical measures should be followed.

IV. Of which restitutorial measures the various methods of uretero-ureteral anastomosis are recommended.

V. Intraperitoneal trans-uretero-ureteral anastomosis is an anatomic possibility; it is also a physiologic success.

VI. Retroperitoneal trans-uretero-ureteral anastomosis, whether anterior or posterior to the aorta and vena cava, is an anatomic possibility. (Further experimentation is essential in order to prove that it is a physiologic success.) The route followed is the shortest path between the two ureters. The technical difficulties are not excessive. It is highly probable that this method impairs the ureteric blood-supply less than any other method in vogue.

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting held June 4, 1906.

DR. ROBERT G. LE CONTE in the chair.

GENERAL PURULENT PERITONITIS.

DR. GEORGE G. ROSS reported eight cases of generalized peritonitis, as follows:

CASE I.—Miss Alice H., aged twenty-one, was admitted to the German Hospital, August 18, 1905, with the history that for twenty-four hours before admission she had suffered with severe abdominal cramps, starting in the right iliac fossa, later becoming general, and accompanied with nausea and vomiting; bowels open. On admission, her abdomen was distended and moderately rigid. There was general abdominal tenderness, with the greatest intensity over the appendix region. By the following day, the distention, rigidity, and tenderness were markedly lessened, the bowels had moved, and flatus was passed freely. On the second day, the symptoms had become localized to the right iliac fossa, and on the following day, the third after admission, she was operated. The leucocyte count on the day of admission was 16,200; and on the day of operation, 14,800.

On opening the peritoneum, a thin, blood-streaked pus was found to the outer side of the cæcum and in the pelvis. The abscess cavity was not confined, however, to these localities; as there was infection of the greater part of the general peritoneal cavity.

No attempt was made to remove the appendix. She was thoroughly drained by a glass tube in the pelvis, a rubber tube in the loin, and gauze wicks. She lived sixteen days. On the

fifteenth day, the leucocyte count showed 13,400. On the day of her death, she expectorated a large quantity of fetid pus.

Post-Mortem Report.—Plastic peritonitis about the site of the appendix; a large abscess between the right lobe of the liver and the diaphragm, which had ruptured into the right pleural cavity, and thence into the right lung. The pathological diagnosis was septic bronchopneumonia.

CASE II.—Miss Annie C., twenty years of age, was admitted to the German Hospital September 27, 1905, with an acute attack of appendicitis of twenty-four hours' duration. There was some general distention and tenderness. The point of greatest tenderness was over the right iliac fossa, extending outward to the crest of the ilium. Vomiting and pain were severe and persistent. The leucocyte count was 24,800.

Operation was performed on the day of admission. On opening the peritoneum, free pus escaped. The peritoneal cavity was walled off with gauze-pads, in the hope that the peritonitis was diffused, but not general. When the gauze was removed it was saturated with pus, proving that the general cavity had been invaded. The appendix was removed, and the peritoneal cavity drained with a glass tube in the pelvis and three pieces of gauze. It was not irrigated. Fowler's position and rectal transfusion were used. There was an uninterrupted recovery.

CASE III.—Mrs. Ida A., twenty-eight years of age, was admitted to the German Hospital August 12, 1905, with an attack of acute appendicitis that had begun three days before, but had become severe only the day before admission. The abdomen was distended, tender, and rigid, the tenderness being exquisite over the right iliac fossa, and the rigidity most marked in the lower quadrant of the abdominal walls. There was no palpable mass. The leucocytes amounted to 5,650.

Operation was performed on the day of admission. An incision was made through the right rectus. There was free pus in the peritoneal cavity, in large quantity. The appendix was removed, and found to have perforated, liberating a fecal concretion and pus. The peritoneal cavity was thoroughly washed with sterile salt-solution, and glass drainage was introduced into the pelvis. A counter opening, to the outer side of the rectum, was made for gauze drainage to the bed of the appendix. Fowl-

er's position was used, together with salt-solution by the bowels, every four hours, a pint being used each time. The patient made an uninterrupted recovery.

CASE IV.—Mr. K., twenty-six years of age, was admitted to the German Hospital August 17, 1906. He had been sick two days with an acute attack of appendicitis exhibiting the classical symptoms and signs.

On admission, his abdomen was moderately distended, with bilateral rigidity and tenderness—most marked, however, over the appendix. On the following day, the abdomen had become softer and less distended, and a mass could be mapped out toward the right iliac crest. The leucocyte count was 16,100. The man was operated upon on the fourth day after admission.

The peritoneal cavity, which was infected, was packed with gauze. A localized abscess to the outer side of the cæcum was opened. The appendix, which was gangrenous, had perforated, liberating three concretions. It occupied a position behind the cæcum, running upward toward the liver. It was removed. There was about 250 c.c. of foul-smelling pus in the pelvis, yellowish-white in appearance, and thin in consistency. Drainage was secured with a glass tube and gauze.

The patient lived but twenty-four hours after the operation, profound and continuous sepsis being the cause of death. The postmortem showed a secondary abscess beneath the liver, and fibrinopurulent peritonitis.

CASE V.—Miss A. B., twenty-four years of age, was admitted to the German Hospital August 29, 1905. She had been ill for five days. The attack began with pain in the right iliac fossa, becoming general. Vomiting began on the third day of the attack. The bowels moved freely.

On admission, her abdomen was moderately distended and rigid. There was dulness on each side below the umbilicus. The flanks were tympanitic and very tender, the greatest tenderness being over McBurney's point. The leucocyte count was 24,000.

The patient was operated upon on the day of admission. On opening the peritoneum, about 750 c.c. of yellowish-gray pus escaped. The intestines were injected, and in places covered with plastic exudate. The appendix was perforated one centimeter from its base. Through this perforation a fecal concretion, pus, and fecal matter had escaped. The pelvis was full of pus.

The pelvis was drained with a glass tube and gauze, four pieces being used. The following day, the woman's temperature was 99.4°; pulse, 116; abdomen, soft. The bowels were moved in forty-eight hours, and gas passed freely. The patient was discharged one month after the operation, with a granulating wound of the abdomen.

CASE VI.—Llewellyn B., sixteen years of age, was admitted to the Germantown Hospital January 18, 1906, complaining of pain in the right iliac region. The attack had come on twelve days before, with some pain and vomiting. The patient felt better after this, but was not entirely well; although he went to school regularly. Tuesday night, two days before admission, he had a second attack of pain and vomiting. A nearby physician made a diagnosis of indigestion and gave some peppermint preparation. The next day the patient went to school.

The same day, the regular family physician was called, and found the boy suffering but little. The abdomen was soft; the temperature was but slightly elevated; and there was some pain in the appendiceal region. The diagnosis of probable appendicitis was made. Salts were given in repeated doses; and the parents were instructed to notify the physician at once, if the patient showed any symptoms of getting worse. At ten o'clock the patient vomited; but he slept the greater part of the night, according to the statement of his father, who did not consider him very sick. He tossed about some, but this was thought to be due to the salts.

Early on Thursday, the family physician saw the patient again, and a diagnosis of appendicitis was made.

The boy was admitted to the Germantown Hospital the same day. On admission, he complained of pain in the right iliac region, but he could not definitely put his hand upon the spot. The rectus was rigid; tongue, slightly coated; mental condition, dull. He was slow to answer questions, and was apparently somewhat excited by the examination. He did not know about his bowel-movements lately, but told about his attending school.

Immediate operation was advised. A lateral incision was made through the right semilunar line. Pus oozed from the wound. The area was thoroughly packed in every direction with large gauze sponges. The omentum was tied down in the

region of the appendix; the lowered end was thickened, and a dark mass of it was found surrounding the appendix. This was tied off and amputated. The appendix on being lifted up, was found to be perforated and dark. Out of the perforation rolled a large concretion. The appendix was ligated and removed; and the stump was inverted and closed over with Lembert sutures. Removal of the gauze pads showed creamy pus in every direction. A glass tube, packed around with iodoform-gauze, was placed in the pelvis. A rubber tube was inserted through a lumbar incision to drain the region of the stump. Three pieces of iodoform-gauze were placed to drain the abdomen; and a fourth piece was used as a cofferdam. Morphin sulphate was given before the patient came out of the ether.

The patient was discharged February 17, with a strip of gauze in the lumbar wound. The fascia was brought together with sutures two weeks before discharge.

CASE VII.—Robert A., twenty-six years of age, was admitted to the Germantown Hospital October 16, 1905, service of Dr. O. D. Whiting, complaining of pain in the lower abdomen, which was tense, rigid, and tender to palpation. Rectal examination showed a fluctuating mass in the right side of the pelvis.

The patient was etherized. A small incision was made through the right rectus. In the right side of the pelvis was an immense abscess, containing a large quantity of greenish-yellow, foul-smelling pus. This was allowed to run out; and the cavity was then sponged and irrigated with normal salt-solution. The appendix was not removed. A glass drainage-tube was inserted into the pelvis. Iodoform drains were placed at the side of the tube, running into the pus-cavity. The patient recovered from the attack, and was sent home.

He was readmitted March 6, 1906, service of author, for appendiceal abscess with intestinal obstruction; pulse 104, respirations 28, and temperature 99.6°. There was severe aching pain in the lower abdomen, which had lasted three or four days, during which time the patient had had no bowel-movements, notwithstanding that purgatives in heroic doses had been given him. The pulse, temperature, and respiration remained normal until after the operation. The abdomen was distended, and had a saggy, doughy feel. There was very slight tenderness in the lower abdomen. The patient had vomited several times,

but there was no fecal vomiting. The general condition, with the history, was strikingly suggestive of obstruction of the bowel; and the patient was operated on, March 7, for that condition.

An incision was made, cutting out the scar of the previous operation. Numerous adhesions, binding the bowel down, were found. These were broken loose, and in doing so an abscess was found in the right pelvis. This was opened and drained, pus flowing freely. The general peritoneal cavity was involved in the infectious process, giving rise to the obstructive symptoms. Four strips of iodoform-gauze were left in as drains, and pushed up toward the liver and spleen; and others, into the right and left pelvis, respectively. A glass drainage-tube was pushed to the bottom of the pelvis. The patient made a satisfactory recovery, after a prolonged convalescence.

CASE VIII.—M. W. was admitted to the Germantown Hospital on February 12, 1906, evidently in the second week of typhoid fever. His previous history is of no importance. Twelve days after admission he complained of a sudden severe, cutting pain in the abdomen, in the region of the appendix. The right rectus was rigid, there was tenderness, and the patient was sweating profusely. The pulse jumped from 78 to 104; the respirations, from 24 to 34. The temperature dropped from 101° to 99.6°.

Operation was performed seven hours after perforation had occurred. The perforation was six inches from the cæcal junction, completely sealed off by omental graft. There was diffused peritonitis. A glass tube and gauze drainage were inserted. The tube was removed in five days, and was replaced by a rubber tube. Fecal fistula occurred on the seventh day. Diarrhœa was the only bad symptom. Death occurred on the 26th, and was preceded by abdominal pain and tenderness, but no vomiting. The temperature rose to 108°; the pulse was uncountable. Perforation took place through the original opening, which had been closed by omental graft. The gut around the opening was gangrenous, as was the gut in touch with the area of the drainage-tube. The peritoneum of the pelvic walls and the parietal peritoneum were gangrenous. General peritonitis was present, and death took place fourteen days after the operation.

Dr. Ross, remarking upon these cases, said that it is evident that general purulent peritonitis is not necessarily fatal. Murphy

claims thirty-three cases of perforative peritonitis with one death. The statistics of other operators show various rates, from 50 per cent. to 70 per cent. of recoveries. In this short series, two out of seven cases due to appendicitis died—a death-rate of about 30 per cent.

The outcome of a case of general purulent peritonitis depends on the character of the infection, the quantity of the infection, and the area involved, rather than on the treatment instituted; although this treatment is a necessary adjunct to recovery in the majority of cases.

Operation should be performed early, and should be minimized to essentials,—*i.e.*, the abdomen should be opened rapidly, the focus of infection at once located and removed, the cavity of the pelvis and the area of original infection thoroughly and rapidly drained, and the wound dressed. The average time for these maneuvers should not exceed ten minutes. Time and the amount of anæsthetic are of great importance. These cases do not stand prolonged anæsthesia and handling of the viscera.

There are some cases in which irrigation is indicated—the cases of late operation, when the pus is thick and creamy. When irrigation is used, it should be thorough. His method was to place one hand in the cavity of the peritoneum, and have an assistant pour salt-solution from a pitcher as fast as it will run into the incision. The hand in the cavity is constantly working and agitating gently the abdominal viscera. This requires an extra five minutes, but is justifiable in these circumstances.

Fowler's position; rectal transfusion, continuous or periodical; and morphin, are important adjuncts to the treatment after operation.

The class of appendix cases most to be dreaded are those in which the organ occupies a retrocæcal position, toward the outer side and behind the cæcum, with the tip of the organ in proximity to the liver. These are the cases that die of sepsis. They develop symptoms early; the symptoms of general infection are severe, rapid, and out of all proportion to the local signs; the organ is so deeply placed that the signs are obscured; and drainage and removal of the appendix does not seem to reach the avenue by which the infection is traveling toward the liver. Even drainage of the retroperitoneal space does not prove satisfactory in all cases.

DR. FRANCIS T. STEWART, although he agreed with Murphy, Le Conte, and others regarding the principles of the so-called Murphy treatment of general peritonitis, in his own experience results before its adoption were just as good as those since it has been employed. Such results may, however, be accidental and not to be attributed entirely to treatment.

DR. ROBERT G. LE CONTE differed with Dr. Stewart as to the value of the Murphy treatment. He (Le Conte) has had a small series of cases of general peritonitis and has obtained a vastly better percentage of recoveries since adopting the Murphy treatment, the increase being 50 per cent. or greater. In the previous cases he did not employ any one method. Sometimes he irrigated, sometimes he sponged, and consequently the treatment varied. Formerly his mortality at the Pennsylvania Hospital was 70 to 80 per cent. His results now are not so good as those of Murphy but they are at least twice as good as they were previously. Whether or not this showing is accidental he cannot say. He is not prepared to state positively, but he believes the results are due to the treatment. The rationale of the method appeals to him very strongly, and he regards Murphy's method as the ideal way to treat cases of diffuse septic peritonitis.

DR. ROSS agreed with Dr. Le Conte as to the value of the Murphy treatment; it is founded on good surgical principles. It is true that of his seven cases he irrigated two and both recovered, but in them the character of the pus was different. It was thick and creamy, like that found in ulcers. Such cases are not to be feared as are those with thin, blood-streaked pus. The character of the infection is consequently of great importance in cases of peritonitis. In a class of cases mentioned, namely those with the appendix posteriorly and high up, the circulation carries the infection through the liver and the mortality is very high; no method of treatment can save most of these cases. When Dr. Ross is operating and sees free pus he at once puts in ten or twelve gauze pads around the site. These absorb pus while he is removing the appendix and thus save time by withdrawing the pus when later they are taken out.

CONGENITAL FISTULA IN TONGUE.

DR. GEORGE G. ROSS exhibited a man who since birth has had a fistula two inches deep in the median line of the tongue.

From this can be pressed pus-like material containing no epithelial cells nor special bacteria. The cavity holds two drachms of pus. It has been suggested by Dr. Jopson that the condition is one of lingual fistula due to the congenital presence of thyroid tissue at the base of the tongue.

DR. ROBERT G. LE CONTE thought the condition to be one of congenital thyroglossal duct and that misplaced thyroid tissue may be at the end of the sinus. His procedure would be to inject the fistula with colored fluid and then dissect toward it from the submental region until the sinus is reached. This can be followed to its base and the entire affected area removed. Within the past six weeks Dr. Le Conte has seen at the Pennsylvania Hospital a case of different origin but of somewhat similar character. It was a case of complete, branchial fistula. The external opening was at the anterior border of the right sternocleidomastoid muscle and the internal at the posterior part of the right tonsil. The case was treated by injecting the sinus with methyl blue through the skin opening, which was about the size of a hypodermic needle. The sinus was dissected out parallel to the sternomastoid muscle and the duct ligated one-fourth inch from the mucous membrane of the pharynx. Two weeks after the operation the patient was again seen; the wound had healed, and there was no sign of a return of the condition. Dr. McCoy examined the throat of the patient before the operation to see if the internal opening could be detected; the mirror failed to reveal it. That the fistula was complete, however, was shown by the fact that material passed through it when the child swallowed.

NORMAL PYLORUS SEVEN YEARS AFTER A SIMPLE PYLOROPLASTY FOR STRICTURE.

DR. JOHN B. ROBERTS reported the case of a man fifty-five years of age who was admitted to the Polyclinic Hospital on February 27, 1899, complaining of gastric symptoms for fifteen or eighteen years. He had pain after eating, which continued until the stomach was emptied by vomiting. He was weak, emaciated and anæmic. Investigation of the stomach by lavage and other clinical methods caused a diagnosis of stricture of the pylorus with gastric dilatation to be made. On April 4, 1899, Dr. Roberts did an ordinary pyloroplasty by making a horizontal incision through the pylorus and uniting the wound in a vertical

direction. There was no tumor of the pylorus and the condition was considered to be a fibrous contraction. The patient immediately had relief from the pain and vomiting and gained greatly in weight. He was discharged cured about six weeks after operation.

During the next six years he consulted the reporter on two occasions complaining of some gastric distress, which was attributed to a recurrence of the contraction, and it was suggested that he return for investigation, treatment and probable repetition of the operation. After each of these conferences, he, however, disappeared from view. He was a man of limited intelligence.

In April, 1906, he entered the Polyclinic Hospital for the relief of dysuria, under the care of Dr. F. T. Stewart. At the Hospital he complained of no gastric trouble and was able to eat and digest even meat. Dr. Stewart found a mass in the pelvis, which interfered with the voiding of urine, and made an exploratory abdominal incision on May 18. He found a mass, probably carcinomatous, involving the rectum, sigmoid colon and bladder, which was inoperable. The patient died two days later unexpectedly, probably from uræmia.

At the autopsy there were found a few old adhesions between the old celiotomy wound and the anterior wall of the stomach. The adhesions were in some parts quite dense, though most of them were easily broken up. The pylorus, according to Dr. John M. Swan, the pathologist, showed no sign of the former operation, except that the pyloric ring was not as distinct as usual. There was no thickening in this region and the pylorus admitted several fingers. There was some evidence of chronic gastritis with moderate dilatation. The specimen was not preserved for presentation with this report.

Dr. Roberts said that he presented this report to the Academy because it seemed to him to be interesting to have an opportunity to examine a simple pyloroplasty seven years after operation and to find that the mechanical effect of the operation continued to be all that was desired. There has been some discussion as to the value of this procedure, but, in the case under consideration, it certainly was the means of saving the patient's life. It is possible that the condition, for which the operation was done, was a spasm of the pylorus rather than a fibrous con-

striction. The latter condition was the lesion however which he believed to be present at the time he examined the pylorus and operated upon it.

DR. CHARLES F. NASSAU gave the detail of a similar operation he performed five years ago. The patient was a woman who suffered from constant vomiting until she had become markedly emaciated. She was in the Presbyterian Hospital for six weeks, where she was seen by Dr. Hughes. She grew progressively worse, the vomiting being uncontrollable by any method of treatment, and rectal feeding became necessary. No mass was felt in the abdomen and repeated stomach examinations were practically negative. Finally Dr. Hughes thought he felt nodular thickening along the right ureter, though there were no symptoms referable to the kidney. Exploratory laparotomy was performed and no explanation for the condition of the patient was at first found. A peculiar condition of the small intestine was that every three or four inches were fecal balls. These were not scybalous, being easily indented, and between them the intestine was collapsed, giving it a bead-like appearance. The little finger could not be passed through the pylorus and the operation as described by Dr. Roberts was performed. After a stormy convalescence the patient improved very greatly, gaining twenty-five pounds in a relatively short time. Her present condition is good. At certain times if she hurries after a meal she vomits, but she is in very good health for a nervous woman. In the absence of over-exertion the stomach functionates satisfactorily. It is difficult to say what the real condition in this case was, but relief by operation was fully demonstrated. This operation gives a mortality far lower than that of gastro-enterostomy, particularly when there is no dilatation of the stomach to justify the latter procedure.

PERITONEAL EFFUSIONS RESEMBLING BILE IN COLOR.

DR. GWYLYM G. DAVIS said that four cases had recently come under his notice bearing on the question of the origin and character of wound and peritoneal effusions resembling bile in color.

The first case occurred in a man about twenty-eight years of age while under treatment for gonorrhœal arthritis of the knee in a chronic stage. He was suddenly seized with severe pain

in the abdomen about twenty-four hours before Dr. Davis saw him. It became rapidly worse and when seen by the reporter his abdomen was distended, evident peritonitis, slightly more tender at McBurney's point than elsewhere, but with no mass or dulness to indicate that the trouble was mainly at that point. Through a transverse incision over the appendix it was found to be somewhat hardened and injected, but not gangrenous nor perforated and apparently not sufficiently diseased to be the cause of such a widespread peritonitis. There was a large amount of dark, grumous peritoneal fluid and only a slight amount of lymph, but the sponges used (gauze) were stained by the fluid a golden yellow color. Thinking this color might be due to bile, after removing the appendix, the wound was closed and another made over the gall-bladder along the edge of the ribs. The gall-bladder was found bathed in the same dark effusion but healthy. The incision was then prolonged toward the median line and the anterior wall of the stomach examined, with a negative result. An opening was then made through the gastrocolic omentum and the posterior wall of the stomach and pancreas, with the cavity of the lesser omentum, were explored, but nothing was found. The wounds were closed and the patient made a perfect recovery and was soon as well as ever.

The second case was in a young boy with a compound separation of the lower epiphysis of the femur. Several days after the injury the white gauze dressings showed the same golden yellow color as in the first case. He progressed favorably.

The third case was in a man about fifty years old who was brought to the hospital almost *in extremis* with diffuse general peritonitis. An examination showed an injected appendix otherwise apparently healthy. Purulent lymph through the intestines and a large amount of grumous, dark, peritoneal effusion staining the gauze sponges golden yellow. A hasty examination of the gall-bladder showed it to contain bile and it had a patch of purulent lymph on it. It was not at all thickened by inflammatory action but entirely normal in consistency. The stomach was normal. Both wounds were drained but the man died some hours later.

The questions arise as to what causes the peritonitis and why was the effusion golden yellow in color? In the first case

the appendix was almost certainly the cause of the disease, as its removal and cleansing of the abdomen cured him. In the third case either the appendix or gall-bladder could be possible causes but neither was perforated; and it seemed more likely that here again the appendix was the primary focus. The pancreas was not the source in either case. Both cases lead one to think that the most virulent types of peritonitis can be produced by a diseased appendix with no adhesions, no perforation, and only showing a slight injection.

As regards the peculiar color of the effusion it was due to disorganization of the coloring matter of the blood. That it was not due to bile in the first case was shown by its absence being demonstrated by a chemical examination of the effusion. In the second case, as it was one of compound separation of the epiphysis of the femur, it was evident that bile could have had nothing to do with it. In the third case the gall-bladder was found to contain bile which did not exude through any perforation of its walls when subjected to pressure, hence it was probably not the source of the bile-colored effusion.

These facts should teach us to be chary about attributing to effusions which stain gauze sponges a golden yellow color a biliary origin.

In a case recently of rupture of the liver, as soon as the abdomen was opened black liquid and clotted blood poured out; when this was rapidly cleansed away the intestines were seen stained over a large area a dirty yellowish-brown color. They were positively stained and not, as in the former cases, of a red color and bathed in a dirty liquid.

On examining the liver a deep rent was seen to the right of the gall-bladder, extending completely through its substance from the transverse fissure on its lower surface up through the free edge to the coronary ligament on top. This man died four days later, possibly of biliary toxæmia but not of hæmorrhage or peritonitis.

THE WEAKENING EFFECT OF A LONGITUDINAL INCISION THROUGH THE RECTUS MUSCLE.

DR. GWILYM G. DAVIS reported the case of a man about forty-six years of age, who had been operated on for appendicitis about a year previously. It was a suppurative case, with drain-



FIG. 1.

age, and the incision was made through the right rectus muscle about an inch from its outer border. It extended from an inch and a-half above the umbilicus to three inches below. He was a stout man and wore an abdominal belt. After recovery the rectus muscle in the region of the wound began to protrude and particularly when the belt was off gave him considerable discomfort. He applied for treatment because during the past two months the protrusion had markedly increased.

On examination the scar was found firm in its full extent; there was no parting of the muscle with hernial protrusion through the line of incision. There was no ventral hernia but the whole rectus muscle opposite the level of the incision bulged forward. The line of the incision can be distinctly seen in the photograph (Fig. 1), not as a protrusion but as a depression with the bulging of the paralyzed muscle alongside. In this case it is probable the tenth, eleventh, and twelfth thoracic nerves were divided. The patient was treated by widely excising the scar and sewing the anterior and posterior layers of the sheath of the rectus and the muscular fibres together in separate layers.

In the January 1906 issue of the *ANNALS OF SURGERY* he had published a paper in which he had advocated a transverse incision for the operation of appendicitis and gave as one reason the avoidance of injuring the nerve supply to the rectus muscle. This case is illustrative of that point. The popularity of the incision through the rectus can only be accounted for by the belief that the amount of paralysis of the rectus which is produced is unimportant.

That this is so, at least to a considerable extent, when the incision is quite small, may be admitted, but frequently what are expected to be easy cases prove to be more difficult. The desirability of additional room causes the incision to be enlarged and also sometimes pus necessitates drainage and then the incision is not so innocuous and conditions such as shown in this case occur as sequelæ.

DR. CHARLES F. NASSAU said he had a great deal of interest in the subject of abdominal incisions as during the past eight years he had studied the effects of many rectus incisions in his gynæcological work at the German Hospital. He has become convinced that a large percentage of abdominal cases are followed

by paralysis of the abdominal wall or by hernia. We say that if wounds heal by first intention there will be few hernias, and this has been well shown by Maurice Richardson. But while it is true that primary suppuration of a wound exercises a great influence on the subsequent occurrence of hernia, at the same time we often see hernias when the appearance of the scar indicates that union by first intention had occurred. The appearance of the scar may be misleading, but when this is reinforced by questioning the patient as to the length of time in bed and the number of times the wound was dressed, the conclusion must be reached that hernia occurs even in wounds that heal by first intention. Unquestionably these cases are due to paralysis of the inner side of the rectus muscle which has been deprived of its nerve supply. Analogous cases are those known as crutch paralysis, wrist drop, etc., which follow interference with nerves, and prove that paralysis may be due to such injury. If the nerve supplying a muscle be cut, the muscle becomes valueless and gradually gives way with resultant hernia. All surgeons who have performed kidney operations necessitating extensive incisions have noted that afterward the entire side of the abdominal wall hangs pendulous. When Dr. Nassau makes a median incision he cuts the sheath of the rectus muscle and then pulls the muscle from the median line and avoids cutting it if possible. He began using the method advised by Dr. Davis before his paper appeared and has become convinced that if one employs this method or a modified McBurney, going toward the median line and downward when it is necessary to get into the pelvis, that paralysis will not follow. He operated on a patient last fall and through the incision determined there was no tubal or ovarian disease and also that there was no distention of the gall-bladder and there has been absolutely no paralysis since. When surgeons used the incision known as Sonnenburg's they recognized that the farther out it was made the less danger there was of hernia. This was due to the fact that in the latter instances none of the nerves supplying the internal oblique were cut. One can make the wound by the Davis method large enough to allow of any reasonable manipulation and yet by suturing layer to layer secure a firm wall if there be healing by first intention. If such incision be used in bad cases of appendicitis, not of the desperate type but those in which there is a question of drainage,

the wound may be completely closed after a small wick is placed under and passed out posteriorly in the loin. Surgeons will find this incision more satisfactory the oftener it is employed. A second incision is of course necessary when the gall-bladder is diseased. An advantage of the Davis incision is that one can go down to the rectus muscle, pull it to the inside, and thus secure a great deal of room. Then if it be necessary to go into the pelvis the incision can be prolonged along the rectus because this will be below the nerves. On account of the frequency with which this is necessary in women, Bloodgood often starts with a U-shaped or boomerang-shaped incision in the skin. One of course should not employ the incision if suspicious of pelvic disease in women, but in men it serves every possible purpose.

DR. ROBERT G. LE CONTE said he did not like to disagree with the proposition of Dr. Davis, but that he had performed hundreds of operations through the right rectus muscle, with and without drainage, and with perhaps two exceptions he has no knowledge of subsequent hernia. It is true that the patients at the Pennsylvania Hospital belong to a nomadic class and the statement does not mean that hernia has not occurred more frequently but that he has no knowledge of it. He incises the fascia fully and then tears the muscle fibres apart with his fingers. In tearing through the muscle the nerves are usually stretched but not lacerated. If the incision is more than three inches in length one or two nerves may be seen as white flaccid cords, traversing the incision. He frequently separates the muscle bundles above or below these little threads in the wound. There is no paralysis of the rectus from this incision. He is of the opinion that the incision recommended by Dr. Davis does not give much more room than does the McBurney incision unless muscle fibres are cut across.

ACUTE HÆMORRHAGIC PANCREATITIS.

DR. FRANCIS T. STEWART reported two cases of acute hæmorrhagic pancreatitis. For the privilege of operating upon and reporting Case I he was indebted to Dr. Robert G. Le Conte, and for Case II to Dr. T. G. Morton.

CASE I.—J. H., female, aged forty-eight was admitted to the Pennsylvania Hospital May, 1, 1906. About sixteen years

ago she had an attack of jaundice, which left as a legacy a severe indigestion characterized by more or less continuous epigastric pain, worse after eating, and attacks of vomiting. There has never been any blood in the vomitus or in the feces. The patient has lost considerable weight and has become a morphin habitué. During the past few years she has also had several attacks of "kidney trouble", *i. e.*, the lower extremities would become œdematous and the urine dark and reddish. Two days before admission the pain became agonizing and the vomiting continuous.

On admission the temperature was 99 F., pulse 92, the respiration 36, and the expression anxious. There was excruciating pain in the epigastrium reflected to the back and to the left shoulder. The whole epigastrium was tender and the muscles moderately rigid. Beneath the muscles could be felt a mass stretching across the epigastrium. An incision through the right rectus muscle revealed scattered areas of fat necrosis on the great omentum and one spot on the jejunum. The pancreas was exposed by tearing through the gastrocolic omentum; it was twice the normal size, indurated, infiltrated with blood, and covered with areas of fat necrosis, one of which was excised and proven to be necrotic fat on microscopic examination.

There was no free blood in the lesser peritoneal cavity. A horizontal incision about four inches long and about one-quarter of an inch in depth was made into the pancreas and packed with gauze for the purpose of drainage; there was very little bleeding from this incision. The gall-bladder, which was tensely distended with dark bile, was drained, it being fastened in the upper angle of the wound. No stones could be found. Cultures from the pancreas and gall-bladder made at the time of operation were sterile. No pathological lesion could be detected in the stomach. Urine yellowish red, cloudy, whitish sediment, acid, S. G. 1022, considerable amount of albumin, no sugar, many hyaline and rather coarsely granular casts and leucocytes, and a few epithelial cells. Hewitt's test for lipose negative. Several subsequent urinary examinations were made with practically identical results.

Subsequent to operation the pain was markedly relieved but did not wholly disappear for three weeks. The gall-bladder fistula closed in three weeks, but there is still a small sinus at

the lower angle of the wound marking the site of the pancreatic drain; pus from this sinus shows the ordinary pyogenic bacteria but no necrotic fat.

Case II.—C. W. female, aged fifty years, was admitted to the Pennsylvania Hospital November 25, 1899. She had never been ill before. The present illness began three days ago with sudden sharp pain in the epigastrium and vomiting. Previous to this the bowels moved regularly each day but since there has been absolute constipation. Purgatives and enemata were given each day without result. On the second day of illness the pain shifted from the epigastrium to the left iliac fossa and the vomitus became black and foul-smelling. On admission the temperature was 99 F., pulse 120, and weak, and the respiration 36. The countenance was pinched and covered with perspiration, the tongue red with a white strip down each side, and the breath fecal. The abdomen was distended and most tender in the left iliac fossa. Vaginal and rectal examinations were negative. Diagnosis, intestinal obstruction, Immediate operation, Median incision below the umbilicus revealed disseminated fat necrosis.

The patient's condition at this time was so serious that the wound was hurriedly sutured. Death at the completion of operation.

Postmortem made through the abdominal wound by Dr. J. A. Scott. Omentum speckled with round, yellowish white, slightly raised areas varying in diameter from one eighth to one-fourth of an inch. The mesentery but not the intestine showed the same spots seemingly following the blood-vessels. On microscopic examination these areas are found to be composed of fat droplets, granular material and many crystals. The pancreas is covered by a bloody plastic exudate, is indurated and about three times its normal size. The peripancreatic fat is necrotic in numerous places. The pancreas itself is deep red in color and shows numerous necrotic areas; it is infiltrated with blood, the hæmorrhages being most marked in the body and tail.

Urinary examination revealed albumin and casts, but no sugar.

DR. STEWART stated that one point was worthy of discussion. The general advice in textbooks is to open and drain, but they do not say whether the pancreas should be punctured or incised,

or if the lesser peritoneal cavity alone should be drained. Laboratory workers say to avoid incising the pancreas because the secretion exerts an untoward effect upon adhesions, the surrounding fat, and even upon other tissues. In the case reported he incised the pancreas. Is this the proper procedure? It did no harm in this instance, at least.

He recalled a case of gunshot injury of the pancreas, the bullet going also through both walls of the stomach. It occurred soon after Park advised posterior drainage in such cases, but the wound was so clean and the peritoneum in such good condition that he did not drain, even after reading Mikulicz's statements on the subject. The patient recovered, hence leakage could not have been great. Park, Körte, and others advise posterior incision below the lower pole of the left kidney for drainage after the first incision has been made in front, the latter being usually done in order to make the diagnosis. In some instances they close the anterior wound after draining posteriorly. In his case he drained anteriorly.

SURGICAL PROGRESS.¹

GENERAL SURGERY, PATHOLOGY AND THERAPY

I. Experimental Research into the Primary Bacterial Contents of Operative Wounds, with a Proposal as to their Protection. DÖDERLEIN (of Tübingen) reported on the primary flora of the abdominal cavity and incision in one hundred coeliotomies and in similar previous work.

His tests showed that in spite of the most vigorous protection afforded by modern aseptic technique, consisting of rubber gloves and cuffs, masks, Küstner's rubber-covering of the abdomen, etc., the abdominal cavity as well as the incision invariably contained bacteria. This agrees with his previous investigations as well as with those of others in which a germ free-field was unattainable. Döderlein is also in accord with other authors in considering the skin of the operative field the last and most important source of the infection. To exclude this source it does not suffice to disinfect the skin, which is as unattainable as the complete disinfection of the hands, especially difficult to reach being the germs in the deeper layers of the skin. He suggests the course to be pursued in which the aim is to hinder the delivery of germs from the skin to the wound. After the patient is prepared by bathing, lathering and shaving, the skin of the entire neighborhood is forcibly rubbed with formalin-benzine or iodine-benzine and then painted with pure tincture of iodine. The object is to render the skin during the operation as sear as possible. Over this iodine paint, is placed with the utmost care a sterile solution of rubber so that it adheres tightly. (This solution under the

¹ Excerpts from the TRANSACTIONS OF THE GERMAN CONGRESS OF SURGERY, held in April, 1906. Translated from the abstracts published in the Beilage zum Zentralblatt für Chirurgie, No. 28, 1906, by J. C. REEVE, Jr., M.D., of Dayton, Ohio.

name "Gaudanin" and an instrument suitable for its application is to be had from Tieger and Wigand, Leipzig.) After the rubber membrane is dry it is sprinkled with sterile talcum to cover its stickiness, and it is now a thin, smooth, shining, sterile membrane, cleaving to the skin, and which can be, after the operation, easily removed by benzine. Many cultures controlled the results with and without this rubber protective, and showed that with it Lister's ideal of a germ-free operation could be attained.

VON BRUNS (Tübingen) said that in sixty successive cases, where the usual skin disinfection was done, all contained staphylococcus albus. The imprisonment of these skin bacteria is urgently needed and is accomplished in an ideal manner by this rubber covering. It sticks remarkably and is durable in spite of its thinness. With it it is possible to keep an aseptic field in a region rich in bacteria. In his clinic the stock solution of rubber coming from the factory is diluted with iodine-benzine to an iodine percentage of 2, and before applying the rubber a disinfection is done by applying a one per cent. solution of iodine-benzine.

HEUSNER (Barmen) rejects entirely the washing of the skin and instead paints it with a one percent. iodine-benzine solution to which is added a little paraffin oil (liquid vaseline) by which means the germs are fixed.

VON OETTINGEN advises, especially in war, surrounding the wound with a solution of mastic 20 grams, chloroform 50 grams and linseed oil 20 drops, and affixing to this sterile cotton.

II. The Secretion of Bacteria by the Sweat-Glands.

WEDE (Königsberg) concludes that up to the present time there has been no clear proof that bacteria have been secreted by the sweat-glands from the blood current.

III. A New Hemolytic Reaction of the Blood-Serum in Cancer Patients and its Diagnostic and Statistical Employment in Surgery.

KELLING (Dresden) claims that the blood

corpuscles of certain vertebrates, especially of chickens, less frequently of swine and sheep, are more quickly and strongly dissolved by the blood of cancer patients than by the blood of other patients or of well persons, and also than are the corpuscles of other vertebrates. This reaction is parallel to the precipitin reaction; with it under certain experimental conditions tumors that are not palpable may be diagnosed; the specific solubility is constant with one and the same cancer. As the primary tumor so is the reaction of the metastasis. Extirpation of the tumor abolishes the reaction. The reaction is independent of the cell-form. The reaction is to be obtained by injection of the tumor tissues into the animal body. Tumors are to be divided into two groups—those to which vertebrate corpuscles react and whose cause is to be traced to embryonic vertebrate cells, and those to which vertebrate corpuscles do not react and whose cause is to be sought in the cells of vertebrates.

IV. Bier's Constriction-Hyperæmia for Acute Inflammation. HABS (Magdeburg).—Contraindications are, first, erysipelas. In four cases the erysipelas spread beyond the tourniquet; indeed it became worse. Second, presence of venous thrombosis (embolus of lung in one case). Third, diabetes. Arteriosclerosis is no contraindication. In four cases of wounds was it applied where surgical aid had been neglected or had made them worse, also where a foreign body was extracted. In all was suppuration prevented. It is not applicable in syphilis.

KÖRTE applied this method in spite of diabetes to a phlegmonous panaritium. The phlegmon retired and the finger healed.

CROCE finds the results not satisfactory in osteomyelitis. He recommends small incisions; also in beginning phlegmon which they do not harm. The application (through exhaust cups) to panaritium is too painful and does not give good results. But with subpectoral and axillary abscesses it is satisfactory. In perityphlitic abscess

the "sucking" does good if there is no communication with the bowel. Very good for stitch abscesses.

SICK has treated 250 cases by this method with generally favorable influence, especially so in severe phlegmons. He mentions the lessened pain, the quicker healing, the better functional result. It worked deleteriously in streptococcic phlegmons, causing acute gangrene of the skin, the same in diabetics, in varicose ulcers and thrombophlebitis. One patient died. In single cases of erysipelas the method was remarkable, but in one great swelling and pain led to the abandonment of the tourniquet, after which the erysipelas retired. Often erysipelas appeared with the constriction of suppurating wounds. In anthrax two cases were good. One could not stand the extreme œdema. In one case of osteomyelitis of the tibia shaft appeared suppuration of the knee-joint. A girl with severe angina and suppuration of the shoulder showed good results.

The method is suitable for hospital treatment only, as it must be watched.

STICH reported on two hundred and more carefully recorded cases of uniformly favorable courses. Particularly in acute tendo-synovitis and panaritium. In these constriction was combined with small incisions and the utmost avoidance of tamponade. An unfavorable course is to be ascribed to technical difficulties.

In acute osteomyelitis the method has often disappointed and he will here open the bone at once, on the ground of the following case: A typical osteomyelitis of the upper end of the humerus in which in the course of a week the entire diaphysis became necrotic. No disadvantages were noted in erysipelas, nor the formation of abscesses under the hyperemia in cases of general pyogenic infection. Particularly valuable seemed its use prophylactically in wounds after primary union but suspected of deeper infection.

DANIELSEN reported on 260 cases, and many more. It failed in 2 percent. Even if the signs of inflammation do not retire in a few days the constriction should be con-

tinued. Only when these pass beyond the line of constriction, and high temperature appears, should the old treatment be adopted. Danielsen has seen good function follow partial tendon necrosis.

BARDENHEUER acknowledged himself a convert. At first he had many failures and it was not till he had met an assistant of Bier's that he became proficient in technique and had good results. The method requires much attention and skill and must not be permitted to wander from the hand of one assistant to the other. He had had exceptional results in teno-synovitis, acute knee-, foot-, elbow-, shoulder-, and finger-joint disease, acute osteomyelitis and periostitis, phlegmonous bursitis, carbuncles. The functional results in the first were very good. Several of the osteomyelitis cases were severe and of the whole number a good percentage were healed without incision. In suppurative joint-disease, primary and secondary, complete function often followed. Once this followed suppuration of the leg, ankle and foot.

HEIDENHAIN.—Most important is the knowledge that the œdema will disappear in the interval between applications. Pus must always be evacuated. He opens the tendon-sheaths in the fold of the skin, thus hiding them and leaving them more pliable. Scars after this treatment are movable, and on this account he uses the treatment twice a day prophylactically in wounds of the fingers.

LEXER said that this treatment can be adopted without danger only in relatively light forms of inflammation; in severe it is a game of chance. Here more than with any other treatment depends the result upon the severity of the infection and the resistance of the tissues. In all light forms with little fever he had good results. The entire course however was not shorter, since one is forced to watch over the case in order to avoid sequelæ. In severe cases the results are various. Favorable courses stand opposed to unfavorable, local and general. An explanation for this Lexer sees in the heightened processes in the inflamed

area, which in serious infections is harmful to the tissues. In consequence of the locally-increased protective juices an increased bacteriolysis appears. Through this a great quantity of endotoxines become free and accumulate during the constriction, which, according to the length of the application and the grade of concentration harm the tissues and so prepare a ground for the tissue-dissolving ferments. Hence the cataplasma effect of the hyperæmia, the rapid and far-reaching melting of the infiltrate, the extensive undermining of the skin, the breaking of pus into sound tissue and the often protracted course through ever renewed infiltrate and abscess. . . . A general infection can appear through increased absorption after removal of the ligature. Indeed the entire effect which one ascribes to the tissues may depend on the small incision. But these work a minor rôle only, are small and applied late.

All the disadvantages which this method brings upon a much-inflamed tissue disappear when we deal with a wide-open wound or where pus collections have been widely opened before the constriction. Here there is a mechanical washing out of the infection by the transudate, and the old methods have at the same time full play. Lexer therefore recommends the method only as an adjunct to tamponade (drainage).

The suction treatment (by exhaust cups) works excellently and rapidly in light infiltrations or in furuncles where there is a necrotic core. In progressive inflammations without demarcation the course in spite of small incisions easily miscarries, dissolution is easily increased and extensions to deeper planes are often promoted. The infiltrate is more and harder than after incision without exhaust.

PERTHES already in 1898 published the value of "aspiration" (*i.e.*, exhaust). If a heavy dose of strychnia be injected in an animal, an incision made in the region and exhaust applied the animal does not die. The same experiment with incision but without exhaust leaves the animal with severe but non-fatal symptoms. With exhaust and

without incision severe symptoms remain in abeyance so long as the exhaust continues. When the exhaust ceases fatal cramps appear. So is shown the value of Bier's method, especially when combined with incisions. To attain a uniform exhaust Perthes uses a form of Bunsen aspirator in which the exhaust is regulated by the difference in level of two reservoirs of water.

CANON recommends gradual release of the ligature to avoid washing of bacteria into the blood-stream.

HOFMAN by means of a constrictor at the height of the navel had brought about a *dry* gangrene in a case of urinary phlegmon. If the constriction is too tight we get a lessening instead of an increase in the blood-pressure.

HELLER reported two cases of gangrenous erysipelas which healed rapidly. Once thrombosis of the arm veins occurred. He wished an exact formula with which to apply the method. In long suppuration, in lowering of the body strength, then away with constriction.

KÜSTER had seen rapid healing of a suppurating echinococcus of the kidney with evil odor.

THÖLE said that the Bier method was unscientific. It is to be condemned on teleologico-anthropomorphological grounds. Against it is also the theory of the vasomotor nerves, usually entirely neglected.

HAASLER, owing to lack of an autopsy, had failed to prove the relationship between an axillary abscess treated by constriction and a following fatal meningitis.

In order to exclude subjective impressions he compared fifty cases of this method with fifty treated by the old methods. The two series were as much alike in every particular as could be. With these (progressive forms of inflammation) he failed to find any superiority in the Bier treatment!

With well demarcated inflammation like furuncle it was different. Here, especially in mastitis, it possessed great advantages. Also in gonorrhœal arthritis.

STETTINER.—The employment of several little glasses (cups) would not replace one larger. . . . He often saved the last phalanx where it was formerly lost. In mastitis suckling was but briefly interrupted. Where there is much secretion from a wound where the drains have been early removed, suction does much good. The healing of old fistulas without curettage was made possible.

GEBELE had seen one fatal result from mastitis with many little abscesses leading to ablation.

KLAPP recommended providing the finger-cup with a cuff formed from a rubber finger-cot.

BIER supplied much material. The cases of osteomyelitis healing without necrosis were the lighter forms. In joint troubles he expected much. The severe traumatic suppurations were often followed by good functional results. About 60 percent. of ear suppuration was followed by good hearing; acupuncture only of the mastoid abscess. Only early cases are suitable for this treatment. No good results were noticed in erysipelas and in streptococcic infection.

Active motion was better than passive, especially that in the warm bath. The whole process is yet too little understood to give the *rationale*. Permanent constrictors he had not entirely abandoned, but they are to be avoided. Pain during constriction is not always a contraindication; it often depends on the technique. The general principles were that the hyperæmia did not cause pain but lessened it, did not cause necrosis but prevented it; that inflammation was finally a protective process.

V. The Treatment of Surgical Tuberculosis by the Exhaust Dry Cupping Method. KLAPP (Bonn) said that this is the best means of treatment, especially of the acute local inflammations. The length of the applications need not be closely adhered to. The forms tending to softening (to fistulas, etc.,) are best adapted to this treatment. The opening of cold abscesses is not justi-

fied if they have not been treated by exhaust. If opening occurs the expected secondary infection does not occur. Experiments show that open tuberculous tracts thus treated have very slight infection. He likens this treatment of synovial tuberculosis, combined with frequent puncture, to the favorable results obtained by the oculist in puncture of the anterior chamber in tubercular iritis.

VI. On the Prophylaxis and Treatment of Tetanus.—POCHHAMMER (Griefswald) said the serum treatment of tetanus is insufficient. After the appearance of the cramps the antitoxin is ineffective. More is to be expected from the prophylactic use of the antitoxin, which has much to recommend it on several grounds. He reports a failure where a reliable serum was injected fourteen hours after a severe machine wound of the foot. Healing satisfactory. On the fourteenth day signs of local spasms and drawing pains in the bone. Three weeks later pronounced general cramps; tetanus ascendens (which is confined almost exclusively to animals), protracted course and death from diaphragm involvement after the local spasm had passed. The injections had decidedly controlled the beginning and course of the disease but did not reach to the end of it. Pochhammer therefore advises a repetition after ten or fourteen days.

KÖRTE thought there was less tetanus now. He would hesitate before using antitoxin prophylactically.

DEUTSCHLÄNDER reported a stormy case of tetanus in spite of prompt injection. After free evacuation of fluid under high pressure by lumbar puncture in one hour the disease ceased.

HECKER.—Every severe wound is treated by injection, and we never see an ill effect.

RIEDINGER.—Territorial extent is important. He had made two amputations without rescue.

KÖRTE had cured a puerperal case of severest form by morphine and chloral. He never uses prophylactic injections and yet never sees tetanus.

KRÖNLEIN has injected intravenously as well as subcutaneously and is skeptical.

BRAUN has seen four cases in spite of prophylactic injection.

POCHHAMMER thought it to be safer to inject all wounds of the feet, especially those soiled with garden earth and wounds containing foreign bodies, especially gunshot wounds.

VII. On Laparotomy under Spinal Anæsthesia and Scopolamin Sleep. KRÖNIG said the first alone even in its best forms has been utilized very little in abdominal and gynæcological operations because the unpleasant effects are so serious. The unpleasant position of the patient, the tied arms and the commands of the operator make a distinct disturbance on the mind of the patient; too inhuman. With relatively small doses of scopolamin-morphine we may produce a condition in which the parturient perceives the pain but does not apperceive it; forgets it immediately. In ten weeks he applied this method, to the exclusion of all inhalation, to 65 cœliotomies, 28 vaginal cœliotomies and to 160 major gynæcological and obstetrical operations.

Technique.—About two hours before the operation inject 3 decimilligrams of scopolamin and 1 cg. morphine. Repeat in an hour. An hour later if the patient is not in lethargy, "twilight sleep," tested by her recollection, scopolamin in dose of $1\frac{1}{2}$ dmg. is injected. Krönig does not use more than 9 dmg. scopolamin nor 2 cg. morphine. If this is not sufficient nitrous oxide is used, and if this fails, chloroform-ether. The latter was never necessary when injections were also made into the spinal canal. To block all the senses black spectacles are used and double screens to the ears. Into the spinal canal stovain-bouillon was generally injected, .08 to .12 cg. stovain for laparotomies and .08 cg. for vaginal cœliotomies.

The patient sleeps deep and quiet through the operation. The chief advantage is in the after condition; 154 out of 160 had no nausea nor vomiting. Fluid is soon

given. Bronchitis has never been seen. After the most severe operation patients rise in two to six days. In three percent. severe headache.

VIII. Silver Wire as a Percutaneous Deep Suture.

E. KÜSTER (Marburg).—As a precaution against bursting open of the (abdominal) wound Küster uses through-and-through sutures of silver wire and then closes the wound in layers. Where there is infection and need of drainage the wire is placed to be closed later. In tuberculous peritonitis the suture must not reach quite to the peritoneum. He uses this also in hernias, wandering kidney, broken patella and long bones, and resections. The sutures are easily removed.

IX. General Lymphomatosis treated by Röntgen Rays.

CLAIRMONT (Vienna) reported the history of a tumor, 5 cm. high, which extended over the back of the hand and forearm, situated in the skin. With it was general enlargement of the lymph-glands, of the liver and spleen, and small skin tumors on neck, back and both feet. Microscope proved it to be lymphatic in its origin. In a month the hand was subjected to the rays 30 times for 10–15 minutes each time. The tumor has almost disappeared and the patient returned to work. Less treatment to the other parts has caused distinct improvement. Whether lymphosarcoma or pseudoleukæmia is to be determined.

X. The Behavior of Bone Arteries in Disease and Fracture.

DELKESHAMP (Königsberg).—The method used was to inject the vessels by an emulsion of mercury and turpentine, then take out the bone and take skiagraphs. In joint tuberculosis was a great overgrowth of the epiphyseal artery. In only one case was a tortuous dilatation of the nutria tibiæ, showing an increased friability. In a case which had osteomyelitis and sequestrum thirty years before the lower nutrient artery was completely lost and replaced by a rich net-work of periosteal arteries. A deformed elbow in syringomyelia showed a complex net-work of the epi-

physeal artery, anastomosing much with itself and with the nutria. In rickets there was the greatest vascularization at the epiphyseal line, the nutria showing a bunching toward the cartilage. In malignant tumors was a pronounced growth of abnormally coursing vessels. Those in the growth were so numerous that the mercury appeared in the skiagraph as an even plane. After removal, the abnormal periosteal vessels were then permitted to be seen. It is by these vessels apparently that the neoplasm extends itself so rapidly.

Fractures exercise an enormous stimulus on the nutria. It responds with the building of new branches which appear in the earliest days after fracture. At the completion of consolidation the vessels retire and become normal soon after six weeks. The multiplication of the intra-osseous and periosteal vessels goes hand in hand.

XI. On Cysts of the Long Bones. LEXER (Königsberg) presented a case which sheds new light on the nature of cysts of the long bones. A thickening of the shoulder appeared in a boy of fourteen, four years after a contusion. Diagnosis; central cystic enchondroma. It was found to be a single large cyst containing brown fluid and reaching from the cartilage to the middle third of the humerus. The walls, much honey-combed, consisting of very thin cortex and their smooth surface together with septum-like projections, betrayed the origin to be in a tumor. The entire portion of the bone was subperiosteally resected and replaced by a piece of fibula with periosteum, fresh from an amputation. The periosteum and then the skin were closed. Skiagraph shows the graft covered by a thick shell of bone. Function normal and shortening abolished. Microscopic examination shows, though no tumor tissue was found, the cyst came from the liquefaction of a previous enchondroma. This because numerous hyaline cartilage islands are in the walls.

XII. Osteodystrophia Juvenilis Cystica. TIETZE (Breslau) exhibited a preparation of a cyst of bone which

he believed sprang from an *ostitis fibrosum*. A girl of eighteen received a fall five years before and suffered from great pain in the thigh. She entered hospital on account of a fracture of the right femur. Bone cysts at the site of fracture and in the tibia. Operation. The two bones showed a very thin cortex distended by a fibrous mass which in places plainly showed a softening and transformation into cysts. In general it is built on the type of "osteoid tissue," and nowhere cartilage cells. Tietze claimed that in finding cartilage cells near a cyst we were not at all justified in claiming the origin to be *enchondroma*.

The discussion showed much diversity of opinion in regard to the cause of bone cysts.

XIII. Hematogenous Osteomyelitis from Actinomycosis. WREDE (Königsberg).—Actinomycosis of bone comes almost exclusively from extension into the bone from the neighboring tissues, very rarely from metastasis. Only three cases of the latter were found, and then from the lungs with many metastases in the soft parts, the latter overshadowing the bone lesion. He presented a preparation of a focus in the upper end of the femur which dominated the clinical picture; the primary lung focus could hardly be found. Many other metastases.

XIV. On Traumatic Osteoma. KÖNIG (Altona) spoke of the very rare tumors which follow a single trauma without fracture. About eight days after a heavy blow or kick pain appears and a steadily growing tumor. Skiagraph shows a growth first extending out from the bone and then turning upwards—tobacco-pipe form. Usually the growth throws a Röntgen shadow with clearer patches. In a few months growth ceases, or retires. Microscopic examination shows the growth between periosteum and the point of attachment of muscle to bone, partly fibrous and partly ossified. The process resembles periosteal callus and he proposes the name "fractureless callus-tumor."

This conception leads to conservative treatment;

operation only for unbearable discomforts. If forced to operate it should be done radically.

XV. Histology and Radiography of Tardy Forms of Hereditary Joint Syphilis. BOSSE (Berlin).—Most of our knowledge of this disease has come from the oculists, because it is often accompanied by interstitial keratitis. It cannot cause wonder that the cause has been overlooked when it is remembered that other disturbers of nutrition, tuberculosis, rheumatism, etc., may be a cause and that the dog, horse and bear may be subjects of it.

Naturally only the third grade of the disease is to be certainly detected by the radiograph, in which the widened zone of calcification through gummatous process is bulged in "necklace form" or is broken through altogether. The earlier forms were naturally not so distinct and may be confused with rickets. A thorough examination by skiagraphy should be made as to the integrity of the epiphyseal line, including the entire bony system, the short diaphyses and the skull. The relation of our histological to our radiographic observations is in the first case, a gummatous synovitis without certain bone involvement, in the second, the same with the severest epiphyseal and diaphyseal involvement, and in the third, gummata in simple synovitis.

XVI. On the Treatment of Bony Joint-Ankylosis. HOFMAN (Graz).—After mentioning the usually poor results and explaining the cause of failure Hofman describes a new operation. In order to prevent new ankylosis forming from remnants of cartilage he covered the defect with periosteum flap obtained from the tibia. The case was one of complete bony ankylosis of elbow and he resected the head of the radius and chiselled between the ulna and humerus. The flap was tacked (stitched) in place and passive motion avoided for four weeks, when the elbow was at a right angle. Primary union. The patient gradually took up his work and in eight months had rotation and

extension complete and flexion almost complete. Convalescence was painless; no forcible passive motion.

Two members of the congress recommended flaps of muscle or muscle and fat.

MILITARY SURGERY.

I. First Aid on the Battle-field. VON MANTEUFFEL (Dorpat).—The Russo-Japanese war can teach us little that was not already learned from the Boer war. Where shall first aid be served? Considering the long range of modern arms this must be about 4 kilometers behind the firing line, though in mountains it may be nearer. How many wounded are to be expected at the dressing station? About one-fourth of the total number. A surgeon can make about one hundred dressings in a night. The Russian army at Mukden had 75,000 expected wounded and for their care was needed 7,500 doctors, students, and helpers; 2,700 were enrolled, of which a larger part were in the reserve corps. The individual packet was properly used and justified itself.

The question as to the treatment of the skull was left open in the Boer war. Here Von Bergman's rule of "touch not" was proven correct in diametric wounds (*contre-coup*) with extrusion of the bullet. Without extrusion they should still await symptoms and Röntgen examination before operation in the reserve hospital. Otherwise with the tangential wound: must be operated as early as possible. In summer even they run an unfavorable course; in winter worse, because of the greater dirt. Without operation the wounds suppurate and then operation comes too late.

Operate in neck wounds for hæmorrhage only. In thorax, await effusion, and then in evacuating do it gradually as otherwise infection may be sucked from the lung. Wounds of heart, "touch not." Manteuffel has seen seven shot-wounds of heart heal smoothly. The spine gives nothing

new: only the old gloomy picture. In transverse palsy do not operate. If the palsy is not exactly transverse but irregular, laminectomy may be done. Improvements were few. Generally one should await possible absorption of blood-clot. Shrapnel wounds are generally infected; rifle wounds heal smoothly. Bladder wounds, from puncture, heal smoothly. With the extremities follow the old Bergman precept, do not disturb and plaster of Paris at once; this is established by both positive and negative trials.

II. Ability for Service After Wounds from Modern Weapons. SCHAEFER (Berlin), as recipient of the Langenbeck fund, made extensive studies in the field of the Russo-Japanese war. After the battle of Mukden he was enabled to examine over 7,000 wounded who again recovered sufficiently to return to their commands. The losses were undoubtedly great, but the percentage of loss not so unprecedented as the early reports showed. The percentage of wounded compares with that averaged in the Franco-Prussian war. The officers suffered more than the privates. The chances of the individual are shown in a table giving an average of 44 dead and wounded in every 100 men of the First Siberian corps. The relation of dead to wounded was 1-5.5. He reports upon the progress of the wounded. The percentage of deaths after wounds was remarkably small. Though many dead on the field were not reported, the prognosis for the wounded who were carried alive from the field, seems more favorable than in former wars. Surprisingly large was the number of wounded who were again able to report for service. Schaefer found about one-half of the wounded, after the battle of Mukden, able to serve after a period of three months. The report contains a classification of the wounds, as to the parts wounded and the nature of the missiles and weapons. Fifteen per cent. of all wounds were caused by artillery-fire. Mention is made of the operative activity at the main hospital stations, which was minimal. One division hospital counted but 10 operations in 2,000 cases of wounded.

Schaefer relates observations upon the effects of distance in gunshot wounds, and believes that the differences in the structure of the parts hit plays a greater rôle. In the end, he praises highly the first-aid outfits of sterile dressings carried by each soldier.

III. Experiences with the Dry-Dressing of Wounds in the Southwest-African War. GOLDAMMER (Hamburg) prefaces his paper with a mention of the many difficulties experienced by the surgeons in this war. These were largely caused by the constant poor supply of water and the enormous distances from field to base, rendered more considerable through poor means of transport. Under these conditions, dry dressings proved most valuable. Goldammer lays particular stress upon a combination of complete and exact fixation, with sterile dry dressing in all injuries to bones.

IV. Gunshot Wounds of Joints in the Russo-Japanese War. L. BORNHAUPT (Riga), as chief of the hospital of the Moscow-Iberian community, had 157 cases of gunshot wounds of joints among a total of 2,265 cases of wounds, about 7 per cent., compared to 4.5 per cent. in the Franco-Prussian war and 2.5 per cent. in the campaigns in Cuba during the Spanish-American war. The joint most frequently involved was the knee,—in 54 per cent. of all cases. The percentages of the other joints were about as follows: Elbow, 20 per cent.; shoulder, 12.1 per cent.; ankle, 6.3 per cent.; hip, 3.8 per cent., and wrist, 3.4 per cent. These figures have been nearly the same in all other wars. In these 157 cases 68.8 per cent. were bullet-wounds, 25 per cent. were caused by shrapnel and the rest were due to grenade fragments. Except in wounds of the ankle-joint, the other bullet wounds suppurred in 60 per cent. of all cases. Nevertheless these bullet wounds, excepting those of the knee-joint, all resulted well after conservative treatment.

The same plan of treatment gave good results in 95.5 per cent. of wounds of the elbow-joint and in 93

per cent. of wounds of the shoulder-joint. In all joints the impaction of the projectile increased the chances of suppuration 50 to 60 per cent. This impaction and the limited chances for proper transport of the wounded are considered the cause of the severe forms of suppuration encountered. Ready means of quick transport from the field of battle and competent means for fixation of parts at the place of injury surely constitute the two means of preventing many a crippling operation and many a subsequent death.

The hospital treatment of the cases without febrile reaction was an early massage and baths. Some cases were massaged after 5 to 6 days. After the least rise of temperature the massage was discontinued. Extensive hæmorrhages into the joints of the upper extremities considerably delayed the healing.

In many cases of injury to the knee-joint, the patients were able to walk at the end of two weeks.

Of all cases, 23.5 per cent. were operated upon—44 operations upon 37 patients—all these being cases of suppuration. Fourteen operations were amputations, one a disarticulation at the shoulder-joint. Ten amputations were necessitated in knee-joint cases. No deaths were reported after these operations, but mention is made of greatest difficulties encountered in the knee-joint cases.

Bacteriological researches established the following conclusions: Arthrotomy is indicated in all cases of streptococcic infection. Streptococcic infections of the knee-joint should not be arthrotomized later than a few days after injury. If in such cases the patient has been subjected to rather long transport, with perhaps unsplinted leg, no measure short of amputation should be considered. Knee-joints, with staphylococcic infection, may generally be treated with lateral incision of the capsule. In more severe cases the treatment should consist in a free opening of the joint, after the manner of *Textor*, the extirpation of the capsule, and thorough packing of the posterior wall.

Four cases of resection gave 25 per cent. of recoveries, and six arthrectomies 66.7 per cent.

Before deciding upon any operation on a pus-joint, aspiration and bacteriological examination of the pus are of greatest importance.

Of all cases reported, seven died. Of these two were hip—and five knee-joint cases. This meant a death-rate of 4.46 per cent., compared to 3.74 per cent. during the Spanish-American war.

All statistics and experience in this line speak most favorably for a conservative treatment of gunshot-wounds to joints. Secondary infection has been found to but rarely occur. Aseptic dressings, reliable fixation of the wounded joint, and quick and easy transport from the field of battle afford the means for best results.

The method of Bier may later prove of value in these cases.

V. Gunshot Wounds of Blood-Vessels. BRENTANO (Berlin) describes eight cases of gunshot wounds of blood-vessels, which were treated at the Charbin hospital of the German Societies of the Red Cross. The cases were alike in that all presented wounds inflicted by Japanese rifle-bullets (caliber, 6.5 mm.), and in all cases the skin wound of entrance had, at the time of admission, nearly or entirely healed. Of the eight, seven were operated upon. The eighth case revealed at the autopsy a gunshot perforation of the aorta. This patient lived seventy days after receiving the injury, and died of the results of secondary hæmorrhage, not of the perforated aorta, but of the liver. The operation in the seven cases consisted in free incision at the site of injury, double ligation of the vessel and its branches, and resection of same.

All cases recovered, free from any reaction or after-disturbances of circulation. Brentano condemns too early interference; especially in cases of extensive hæmatomata; in such the dangers of infection are great. Subsequent

suture of vessels is rarely possible. Such suture could be made only circular; on account of the extent of the defect could never be linear. Suture would be rendered difficult through the serous infiltration of the walls of the vessels, and their reduced elasticity, resulting from processes of absorption of the blood-exudate. Of the seven operated cases, four were tangent wounds, and three perforating. The first four were three of the brachial and one of the radial artery. The other three were of the external iliac, the femoral and anterior tibial artery, the continuity of the vessel being still preserved in all of these.

Brentano considers the perforating wounds as less likely to close spontaneously.

Of the tangent injuries to the brachial, two cases presented complete closure of the wound at the end of six days.

The closure was effected by a glueing together, through plastic exudate, of the vessel with adjacent nerves and fasciæ. The injury to the artery was undoubted, as the pulse peripheral to the wound was considerably weakened, or entirely lost. Added to this, the extreme toughness of the scar-tissue, and the disturbances of function in the adjacent nerves, left no doubt as to the presence of a lesion to the artery. The dangers of secondary aneurysms at the site of injury were additional indications for operative interference.

In three cases pseudo-aneurysms occurred, which were operated upon eight to fourteen days after the date of injury.

VI. Experiences with Gunshot Fractures of the Extremities during the Russo-Japanese War. COLMERS (Leipsic).—Injuries to bones from the small-calibered Japanese gun proved similar to those in other late wars, and confirmed the results and conclusions of experiments made by the medical staff of the Russian army. Colmers' experience leads him to tabulate the following advices:

1. No attempt at wound-disinfection should be made where the process cannot be carried out—*lege artis*.

2. First dressing should consist in an antiseptic or aseptic dressing, with compression, and the best possible fixation.

3. At the field hospital the only operation to be considered should be the urgently demanded amputations. Bleeding vessels should not be searched for nor ligated at that time and place.

4. Cases of gunshot-fracture should be given the priority of transport to the base-hospital.

5. During transport no change of dressings should be made.

6. The first dressing should not be removed before the patient is entered at some hospital where he can remain for the next two weeks, and this dressing should be combined with fixation by plaster bandage. The writer considers the plaster bandage the best form of retention; it easily permits of successful treatment of even badly splinted and infected cases. X-ray examinations are of great value, but can only be considered in the outfits of hospitals far removed from the field. These cases necessarily pass through the hands of a number of surgeons from the time of injury till the time when they receive their final exact treatment. The writer thinks it well to formulate a fixed plan for handling such cases and to instruct all surgeons to follow it strictly in every case.

VII. Injuries to Peripheral Nerves. HENLE (Dortmund).—Observations are upon comparatively old cases, as the hospital of the German Society of the Red Cross at Tokio was far removed from the scene of the war.

Among 276 patients, 34 (12 per cent.) presented injuries to peripheral nerves. For these injuries 21 operations were undertaken, or 10 per cent. of 195, the total number of operations performed. There were six simple neuralgias, and 11 combined with paralysis. Of these 17 cases six were cured without operation. Of the 11 cases

operated upon, two presented pressure effects upon the nerve, in one case through aneurysm and in one through a scar contraction of the pectoralis minor muscle. Cures resulted in both cases after extirpation of aneurysm and muscle. In four operations nerves and scars were dissected loose and imbedded in soft tissues, with three cases cured. In one case the median nerve was again exposed after three weeks, because the pain had not been relieved, and was again found encased in scar tissue. A part of the nerve was resected, and the site enclosed in a flap of fatty tissue taken from the abdominal wall. The pain ceased, as also in three cases of resection for complicating paralyses and two cases of plugging. A record of 11 cures in 12 cases operated upon. All of the 11 cases were relieved of their neuralgias. The conclusions tend to indicate in such cases operative interference to release the nerves or nerve-ends from scar tissues. The paralyses present more unfavorable conditions, as here often the duration of the affection plays a decisive rôle.

In the cases considered, this was but once as short as two months, usually from three to nine months. In all, 29 cases of paralysis occurred; eight cases recovered without operation; four cases were hopeless; 17 cases were treated by operation; three cases of release of pressure, (two aneurysms, one contracted pectoralis minor)—two cures; two cases of neurolysis—one cure; eight cases of freshening of nerve-ends and suture—three cures.

Suture was made with fine silk. Twice the line of suture was encased with flaps of fatty tissue, once with a portion of injured and resected brachial artery (method of Formatti).

The distance between severed nerve-ends proved too great in many cases to admit of any operative union.

Grafting of one nerve into another gave three results in six cases. These graftings consisted in suturing about one-third of the one nerve into a flap cut from one-third of the other.

Twenty operations were performed on 19 patients presenting paralyses;—nine cases improved, 11 cases without result. Of all but two cured, in the rest the missing functions were but partially restored. Too short a time was permitted to await final results. Most probably some of these cases regained better and greater functional powers of the muscles involved, after they had been dismissed. Stress is laid upon the importance of rapid transport of all cases of injury to peripheral nerves, to a point where exact surgical treatment can be administered.

VIII. Gunshot-Wounds of the Cranium. HILDEBRANDT.—With modern weapons, gunshot-wounds of the cranium were expected to be immediately fatal in most cases. Experience in recent wars has not proven this to be the case, and yet the mortality from such wounds is high—70 per cent. in the Boer war, with a table of at least 50 per cent. of recoveries of such not dying on the field.

The favorable results are ascribed by the writer to the treatment employed. Fatalities resulted mainly through infection. Good results can only be attained through measures which prevent or combat infection. Be it observed that the slanting (tangent) wounds present the more extensive lesions of scalp and bone, and incur the greater risk of infection. The only procedure that can check infection is thorough *débridement* (incision), the exposure of the dura in the entire extent of the wound, and the removal of bone splinters, blood-clots and detritus.

Deeper perforating wounds, with severe symptoms of brain disturbances, gave better results after this same procedure. The operation was desisted from in cases of apparently hopeless injury to the brain, and in cases of perforating wounds, with small and narrow wound of entrance, that were free from symptoms of severe brain disturbances.

V. BERGMANN (Berlin) condemns the early operations in any case of gunshot-wound of the cranium, especially in cases where the wounded must endure a transport lasting

5 to 6 days. He considers the operations in question as only indicated when undoubted symptoms of meningitis or abscess have arisen.

V. Bergmann opposes the method of Bornhaupt, of massaging recent cases of gunshot-wounds of joints, contending that we cannot be assured that foci of infection may not still remain encapsulated in the joint. He advocates long-continued treatment of such cases by exact fixation. He also admits that ligation of vessels on the field of battle must be performed at once in a number of cases to prevent death by hæmorrhage.

ZOEGE (Dorpat) maintains his position in advocating the free exposure of all glancing wounds of the cranium. Referring to his experiences in the fighting line, he finds it best to ligate freely bleeding vessels at the front, and not trust the chances of later operations upon aneurysms. Early ligation prevents (1) many fatalities from secondary hæmorrhage, and (2) infiltrations that obstruct collateral vessels, through pressure, often causing gangrene in the first 3 to 12 days after injury. Both conditions necessitate operative measures at once and mostly under unfavorable conditions. Zoëge emphatically demands the use of aseptic rubber-gloves in such operations in the field.

IX. Abdominal Surgery in War. V. OETTINGEN (Berlin).—A summary of this paper presents, as most interesting, these conclusions:

1. Abdominal wounds with small encased bullets of small calibre are on the whole less severe than those inflicted by the former large lead bullets.

2. Exception may be found in the former class of wounds where they occur at short range (up to 400 yards).

3. The prognosis in any given case must be made with consideration of the following factors: i, Anatomical relations of the wound; ii, Condition before transport; iii, Manner of transport; iv, Treatment.

4. Theoretically, no abdominal wound from a modern bullet should be primarily laparotomized, with exception

of those cases preventing signs of continued hæmorrhage into the abdominal cavity.

5. Conservative treatment is indicated.

6. Abdominal wounds through shrapnel, grenades, and all artillery projectiles present the most unfavorable prognoses.

7. Theoretically these latter cases all demand immediate laparotomy.

8. Statistics show a few recoveries of such cases without operation, against a mortality of 100 per cent. in all cases operated upon on the field. So we must advise against urgent laparotomy, except at the hands of experienced surgeons.

9. About one experienced surgeon is met with in 20 medical officers at the front. These medical officers, who are not experienced surgeons, should be enforced to adhere to a well-arranged, uniform plan in the handling of all classes of gunshot-wounds, especially of abdominal gunshot-wounds.

10. The greatest good and safety to the wounded comes from strict uniformity of treatment on the field.

11. Statistics of the various medical organizations active on the field do not establish a very reliable summary on the subject.

12. Approximately, the mortality of abdominal gunshot-wounds, with conservative treatment, will be 45 per cent. on the winning side, and 55 per cent. on the losing side.

13. Laparotomy on the field cannot better these results.

14. Secondary laparotomy has probably saved many cases where primary operation would have been entirely hopeless.

15. Proper instructions to the individual soldier, and special training of *personnel* of the medical corps in the field, together with improvements in the methods of transport of the wounded, will be the chief means of reducing mortalities in the future.

HEAD AND FACE.

I. Lasting State of Sleep, after Fall upon the Occiput. RÖTTGER (Berlin) reported the history of a man who had lain for 18 months in a condition of sleep, eyes closed, forehead slightly wrinkled; he has spoken no word, nor shown the slightest alteration in his condition during three months of close observation. The interesting points of the case are the absence of every psychical function, and the cessation of every expression of will (patient never asks for food, etc.), and yet the functional activity of the sub-cortical and automatic centers is retained. Simulation and pressure are excluded. Röttger considers it a case of severe hysterical stupor brought upon a dull brain by the shock of a previous legal examination and then by the mechanical shock of a fall upon the occiput. Prognosis very doubtful.

II. Bloodless Operations on the Head under Diminished Air-Pressure, and Observations on Brain Pressure. SAUERBRUCH (Greifswald) said that after his work in the pneumatic cabinet on the chest, he had turned his attention to the influence of air-pressure on the organs and vessels. For example, he applied a pressure of 50 mm. of mercury to the livers of dogs and obtained thereby such compression of the vessels that the organ could be divided "bloodlessly." The accompanying compression of the diaphragm and lung makes practical application impossible. On the skull it is different, because here it is possible to localize the effect much more. Trephining under a pressure of 20-30 mm. is "bloodless." The danger of air embolism is wholly avoided. The application to humans depends upon the effect upon brain-pressure. This latter is treated in the original.—Memorial to Joh. v. Mikulicz, *Grenzgebiete*, June, 1906.

III. Osteoplastic Covering of Skull Defects. BORCHARD (Posen) recommended the Durant-Hecker method,

pushing under the scalp pedicled flaps of periosteum and bone. In 12 cases this has met all requirements, in one a defect 12 x 7 cm. was quickly covered by bone. Applicable to congenital defects of small children. He prefers a modification of the usual method where periosteum alone is used or periosteal surface is turned inwards. He simply slides a flap sideways so that the fresh bony surface comes in contact with the dura or the brain itself.

It is not necessary to take a thick bone-flap; a thinner avoids much hæmorrhage and applies itself better to the brain-surface. Absolutely necessary that there be primary union of the skin. Adhesions between brain and flap are little to be feared since these depend less on the surface of the bone-flap than on wounds of the dura.

Only when the latter is wounded do adhesions form, regardless whether periosteum intervenes or not. Indicated in all cases where immediate reimplantation is not possible.

IV. Operations in the Cerebellar Fossa. F. KRAUSE (Berlin) reported nine operations of whom none died of collapse, hæmorrhage or meningitis; one of the three fatalities was from pneumonia, two because the pressure could not be relieved by removal. The technique (given in full in Brun's Beiträge, 80th birthday celebration of Von Esmarch) is as follows: A flap is made with the base below which reaches in the middle line the occipital sinus, the transverse sinus above, and overlies the sinus sigmoideus. It is necessary to lay free these last two. He has abandoned the electric drill, uses the hand and the Doyen "borer," and the Dahlgreen forceps slightly modified. When the bony flap is turned down the dura is cut in the same line close to these sinuses and turned down. Then the hemisphere of the cerebellum lies free, and by turning the head to one side the rear wall of the petrous bone near the facialis and acousticus is accessible. By pressing the cerebellum to one side by a spatula these nerves may be seen (route to the Gasserian ganglion). If the cerebellum is pushed inwards instead of outwards, more from below

and without than above and within, the vagus, the glosso-pharyngeus and the hypoglossus come into view, into view of the bystanders more than that of the operator.

A completely successful case of extirpation of cerebellar tumor is reported.

BRAUN recommended puncture of the fourth ventricle upon the appearance of symptoms of cerebellar tumor, as there may be only a hydrocephalus of the former. Two or three punctures may then remove all pressure symptoms. Kraus always operates on both sides of the skull. He has no results from puncture of the fourth ventricle, and proposes instead its drainage.

BORCHARDT warned against the sinus marginalis which at times follows the margin of the occipital foramen. In many cases it is enormous, larger than the transverse sinus. It occurs in about 10 per cent. of subjects; always larger on the right side. Hæmorrhage from it could be controlled only by tamponade. From anatomical observations he makes his flap higher—4 cm. over the external occipital protuberance. To control hæmorrhage from the foramina emissaria he drives in small plugs of ivory or wood and cuts them off. He prefers to sacrifice the bone-flaps because their retention makes a complicated operation in itself. When both sides have been opened a breaking of the edge of the foramen magnum has been feared by some as thus endangering the medulla. This danger is slight, as the thick membrana atlanti occipitalis intervenes and beneath it is not the medulla but the "tonsil of the cerebellum."

Most difficult are tumors in the cerebellar-pontine angle, and he had had three such cases. In the first he had removed not only the cerebellar fossa but also the entire ear. (Most of these patients have already lost hearing.) In this way and by ligating and then dividing the sinus transversus he had thoroughly removed one growth, but tamponade was required for the hæmorrhage and the latter's pressure on the medulla caused death in forty-eight hours.

The principal danger in these cases lay in the nearness of the medulla and vagus, and in order to injure these as little as possible Frazier makes the valuable suggestion that part of the cerebellum be sacrificed. Borchardt in one case could not reach the tumor without such step; the resulting prolapse was so great that he could not return the organ and must remove a portion. No ill results were seen in the six days preceding death from inspiration pneumonia.

In another case it was necessary to remove almost all of one hemisphere of the cerebellum. After six months no ill effects, though there is probably a return.

There is a hernia at the site of the bone defect and behind this a collection of fluid requiring repeated puncture.

V. The Nature of Neuralgia and its Treatment by Chiselling out the Nerve Canal and Lining the Same by Soft Parts. BARDENHEUER (Cologne).—The cause of neuralgia lies in a venous hyperæmia of the bony canal, transmitted along the nerve from a peripheral hyperæmia, this becoming permanent because of the unyielding walls and leading to œdema, perineuritis and adhesions. This hyperæmia wanders in time to other branches, to the main stem and to the ganglions. Hence the above treatment accomplished by musculo-periosteal flaps from neighboring subcutaneous tissue.

He reports seven cured cases. In only one was a return, after 13 months, a case which suffered a fracture of the mandible during operation and later a severe phlegmon and bone necrosis. Later cured by excision of callus.

VI. Facial Neuro Plastic. STEINER (Berlin) reported a case of complete paralysis with reaction of degeneration of the facialis from early operation on the mastoid. Two operations, one laying free the facialis, were unsuccessful. Gradual implication of the other side led to the following operation. The accessorius was freed, difficult because of scar-tissue. The facialis was sought at its exit and there cut off. Anastomosis was not made laterally but per-

ipheral end of facial to central end of accessorius, leaving the distal accessorius near by. Improvement began with an itching four months later. Later a movement of the facial muscles with raising of arm or shoulder. More improvement expected. Steiner believes that the prognosis is better the stronger the involved muscles are.

VII. Paraffin Injection and Implantation on the Nose.

ECKSTEIN (Berlin) said only one preparation is without danger, a hard paraffin which melts at over 50° C. This gives also the best results because of its hardness and its tendency not to slide later. Embolism comes mostly from too soft material. The serious misresult of blindness comes not at all after paraffin of high melting point. Generally such will not be absorbed.

When injection is not possible because of scar-tissue the implantation of carved pieces of paraffin (melting point 75° C.) is to be used, or a combination of the two methods.

VIII. Surgical Treatment of Facial Lupus. SCHULTZE

(Duisburg) advocated the radical extirpation followed by Thiersch grafting. Involvement of the whole face does not militate against complete extirpation. If the mucous membrane of the nose is involved the nose is split; if the septum, the nose is kept open till cured within.

IX. Technic of Cleft-Palate Operations. BUNGE

(Königsberg).—By means of a continuous Halstead (Cushing?) buried submucous suture the edges are brought together, and over this is placed the usual mucous sutures of silk. The first suture, which is of wire, has not been knotted and is removed by drawing upon the anterior end.

X. Functional Results after Extensive Removals of Cancer of the Tongue (via Mouth). HEIDENHAIN (Worms) begins with removal of lymphatics of the neck in the middle line and on both sides as far as the clavicle, at the same time ligating both lingual arteries. Pulling the

tongue strongly out it is divided squarely at its base, by Cooper's scissors, protecting at the same time the mouth. The papilla circumvallate can be thus brought to the teeth; if not, the anterior pillar of the palate on one or both sides may be divided by scissors. The functional results are good because the musculature of the mouth has been retained. Radical results also good (as were also Heidenhain's radical result as after cancer of the lips, in which a similar method was followed). In all cases both sides of the tongue were removed.

SPINE, NECK AND BREAST.

I. Operative Treatment of Gunshot Wound of Spinal Cord. BRAUN (Berlin).—A wound of a 5 mm. pistol under the fifth dorsal vertebra in a boy. Immediate complete paralysis, etc. Röntgen rays showed the ball in the canal. Shreds of clothing were found in the dura. The ball was not discovered until the cord was explored by puncture after opening the dura, then at some height; removed by longitudinal incision near the posterior roots. Great improvement after 22 months, and more expected.

In many experiments on dogs, in which foreign bodies were placed in the marrow, a large percentage soon died from early and severe paralysis, those of secondary healing not included. In a few severe cases the attempt was made to cure by removal of the body, once with remarkable success. In one case (of insertion) there was an early and complete recovery.

Indications for operation where there is known to be a body in the canal:

1. Directly proportioned to the severity of the cord lesion, aside from cases requiring operation because of comminution or infection.

2. Light cases with unimportant symptoms throughout or disappearing symptoms should be temporized with; small bullets often find room beside the cord, are difficult

at times to find in a good Röntgen plate, and are falsely localized.

3. Operate in cases with severe cord symptoms and slow or no improvement, which may not be explained by pressure or irritation from an intra- or extra-dural foreign body.

4. Operate only under the best extraneous conditions, good skiagraphs, and segment diagnosis.

II. Total Extirpation of a Median Neck-Fistula.

RIEDEL (Jena) reported a successful result after several operations had failed in the case of a fistula which extended over the front surface of the hyoid; 3 cm. above this it narrowed to a thread and reached to the foramen cæcum. In the former operations this thread had been overlooked, while in other cases the fistula has not been traced because it passed through the hyoid bone, then requiring the excision of the middle portion of that bone.

III. On the Third Thousand of Extirpations of the Thyroid. KOCHER (Bern).—Of these, including all kinds of cases, the fatalities numbered seven. The mortality is naturally greater in malignant cases, and of 36 such cases the fatalities numbered three. Here not the operation but the included ligature of the carotid communis or resection of the trachea or œsophagus is responsible. In eight cases of struma there were no deaths.

In 52 cases of Basedow, there was but one death, and this in connection with a secondary hæmorrhage which necessitated opening the wound.

There remain 904 of ordinary struma. Here were three deaths from strumous complications. One from secondary hæmorrhage in a congenital cachexia thyreopriva, sensitive to blood loss. The second died of pneumonia after the wound had completely healed; known to have atrophy of heart and kidneys. The third had had from infancy a double recurrent palsy with stridor and pronounced myocarditis.

Thus is it justifiable to declare that at the present time surgical treatment is without danger to life even in deep-lying thyroids of considerable size and in old people, if their hearts are sound. The record of Kocher's assistant is one death in 661 cases amongst the more robust charity patients.

These results are a measure of what the results should be in other surgery, since this operation is more difficult than the generality of major operations and may require the extremes of surgical art, especially so the struma intrathoracica.

Not one case of dangerous infection occurred. In 293 cases of benignant struma in private hospital there were but seven in which local infection appeared, and the average stay of these in hospital was 10 days. The simplest asepsis only is used. Much stress is laid on thorough checking of hæmorrhage, which is accomplished by the "Kocher hæmostats." Kocher clings to drainage because of Friedrich's experiments showing the great value of the outward flow in protecting from infection. He also believes that in Bier's treatment by suction (exhaust) at the proper moment, we have a most valuable resource in case of open suppuration. It is important to remove tubes as soon as the discharge ceases, in this clinic in twenty-four hours as a rule.

Danger lies in accompanying organic disease of other organs, especially of the heart. Every patient must be tested for absolute or relative insufficiency and suspicion of this or of disturbed compensation will be quickened by disturbed rhythm or dilatation. As soon as tachycardia and increased dulness appear, and particularly when these are combined with irregular pulse, the efficiency of the heart for increased demands upon it must be tested; this through exertion or tiring as by Gräupner, or through artificially increasing the resistance in the circulation as by Katzenstein.

A sinking of the pressure, measured "Riva-Rocci," from the mean of 150 mm. of mercury under 200 mm. marks

the prospective operation serious. The same measure together with the grade of dyspnœa marks the point at which general anæsthetic must be abandoned. Kocher abandons this whenever the patient is willing to bear some pain. For aside from its danger of a too low sinking of the blood-pressure, narcosis has the disadvantage of distinctly lessening the chance of avoiding the recurrent (in singers). Narcosis farther compromises the asepsis through vomiting.

To avoid these greatest of dangers, the heart complications, we have the old lesson to learn, early operation. And a greater, not to breed artificially a strumous heart by internal medicines which, in certain goiters, have no effect whatever; we mean the excessive and protracted use of iodine, and still more the frequent misapplication of thyroid preparations, which latter often produce more harm than good.

Increasing dyspnœa is generally required as a clear indication for the removal of a stenosing thyroid. But instead of treating the disturbed heart by medicine treat it by early operation; even among surgeons is operation a last refuge in Basedow's disease. Only in its early stages is operation without menace. Warning: do not permit an operation when there is heart insufficiency, as there certainly is in advanced Basedow's.

Early diagnosis of malignancy is not easy. Operation is certainly indicated in all rapidly-growing goiters, as it is in all these causing pressure.

One drawback is the development of slight hypothyroidism after partial strumectomy. This is to be avoided only by choosing in each operation the proper amount of functionally-active thyroid tissue to be left. If this harm cannot be avoided in cases of required excision then can the want be supplied by thyroid treatment, and here is the latter's most brilliant field.

IV. Compression from the Thymus Gland and resultant Death. L. REHN (Frankfurt a. M.).—It is cer-

tain that an enlarged thymus can produce characteristic pressure effects in the mediastinum.

In general it may be said that the thymus consists of two unsymmetrical lobes which are pushed into the forward part of the mediastinum like a cushion. It is enveloped in a fixed capsule and the anterior wall of this attaches itself to the side of the sheaths of the great vessels, the posterior passing over into the pretracheal fascia. It is loosely fastened to the upper part of the sternum close to the attachment of the pericardium and the large vessels. The capsule enwraps the gland like a loose sack.

The arterial supply is not always the same. Generally the thymus artery comes from the inferior thyroid artery and the inferior internal mammary. The veins are strongly developed and empty into the innominate, the inferior thyroid or ima and the internal mammary. The nerves spring from the sympathetic, the lymphatics are sparse.

Close to the outer surface of the capsule run the phrenic nerves. The left vagus and the recurrent come also very near. The gland itself reaches tongue-like down to the pericardium. It covers from above downwards the innominate artery, the left innominate vein, and pushes into the space between the innominate artery, the right common carotid on one side and the left common carotid on the other, lying then on the trachea. This is the space which opposes resistance to the least growth of the gland.

As to evidences of narrowing of the wind-pipe by a large thymus, the author cited 28 autopsies in which pressure marks were found on the trachea and five operations on the thymus in which the existence of thymus pressure was demonstrated by the results.

It is not the weight of the thymus, not the size alone but its form which is decisive. A large flat gland may be without significance, a short thick one may create serious symptoms. Not only the form of the gland, but also the manner of its pressure may vary. In the new born the spot which is most imperilled seems to be where the innominate

artery crosses the trachea. In general there is often a flattening (of the trachea) from before backwards, often a lateral narrowing, indeed there may be a compression of one or the other bronchus. There is no regularity in this respect. Flügge reports another form of pressure, a pushing sideways of the mediastinal contents, and a case is contributed where the œsophagus as well as the trachea was compromised.

With every inspiration the thymus normally sinks into the thorax, with every expiration rises; the stronger the respiration the greater the movement. In children with large glands is often to be seen with expiration a small soft expansion above the manubrium sterni, a manifestation which may have pathological significance. Clinical experience teaches that in thymus stenosis as a rule inspiration only is hindered, and this is now easily explained from the above. The thymus exercises a valve-like influence, being aspirated to a degree during inspiration and pressed out of the thorax during expiration, thus forcing the thoracic organs.

The more forcible the inspiration the more is the wind-pipe narrowed. A slight lifting of the gland, a fixation by suture into its capsule banishes at once and permanently the stenosis.

Not always is the matter corrected so simply. In those cases for example where the gland has grown around the side of the trachea or where it presses hard and immovably. Such cases are often to be recognised by the expiration as well as the inspiration being hindered.

There is also a form of dyspnoea from enlarged thymus which sets in acutely, eventually leading rapidly to suffocation or rapidly disappears. The sudden, wholly unexpected onset of the apnoea is characteristic as is also the possible return attacks, with free intervals. Explanation is difficult. It can come, especially the clinical manifestations, only from a crowded mediastinum, rapidly coming and rapidly going. Such pressure could come from a certain bodily

posture. But we believe that an enlarged thymus which has not so far produced pressure symptoms suddenly begins to compromise the wind-pipe. The child will at once seek to get more air by raising the head, and if it increases this posture by lordosis (of the neck and dorsal spine) a lessening of the mediastinal space will presently occur. This position is significantly described by many reporters of thymus death. One may assume that the new born, infants with weak cervical muscles or men under narcosis may so die, but men capable of bending forward the head, never. Many cases require another explanation.

The thymus must be capable of sudden change in volume. "In my two operations I have noticed how little sufficed to bring about dangerous pressure, and conclude therefrom that slight enlargement may occasion strong effects." Slight swelling may arise through the gland's secretive capability. The small nutritive arteries certainly do not permit of any active hyperæmia but through constricted veins certainly a passive hyperæmia of significance can be produced. When we notice how suddenly a child with quiet breathing and good color becomes on crying cyanotic and with whistling stridor we can not banish off hand from the mind the possibility of a respiratory swelling. Whether the thymus may suffer swelling in infectious processes like diphtheria furnishes opportunity for surmise and very likely there are other such causes to be revealed in the future.

The author relates an example of sudden death from suffocation, in an adult, from congestion and swelling of the thymus. A young woman had been operated upon for Basedow's disease. The operation had proceeded smoothly. An hour later dyspnœa appeared and rapidly increased to suffocation. Autopsy showed the only obstacle to breathing was a remarkably large thymus gland. Ligature of the inferior thyroid artery to the inferior veins had undoubtedly caused a great change in the circulation and, as an immediate result, a great increase in volume of the gland.

A suddenly appearing dyspnœa may have been some time in preparation. To such cases belong those sudden deaths where section shows a flattening of or saber sheath form to the trachea.

The large vessels of the mediastinum appear to be able to resist the pressure longer, but cases are published by Hans Kohn, then from Ranke's clinic and by Lange of pressure on the heart and vessels.

Trachea stenosis from thymus pressure appears not seldom at birth and ends with death. In other cases are noticed in the new born a slight inspiratory sinking in of the front of the neck with restlessness, inspiratory stridor appears and eventually cyanosis. Or a typical feature is stridor upon suckling, and with this dyspnœa is generally lacking. Although nursing infants in particular are attacked, subjects in the later years of childhood, to four years and later, are not exempt. The narrowing of their air passages may occur rapidly as well as gradually.

The stenosis under consideration can thus appear in single attacks of dyspnœa, the child being indeed after the attack entirely free from difficulty. But every acute attack is dangerous, the first as well as the last. There is a familiar sequence, inspiratory stridor, enlargement of the thymus, thymus death. Ten years ago Rehn operated upon his first case of stenosis successfully. Then followed three by Fritz König, Purucker and Ehrhardt respectively. Lately Rehn has been obliged to attack another. The subject was a four months' old child of normal appearance and color. Since birth it showed the retraction of the neck with inspiration. Upon crying though the picture was changed in an alarming way, the face becoming blue, the inspiration noisy (stridor), the fossæ of the neck and epigastrium being drawn inwards. Cyanosis soon followed. In short, the apnœa was serious. The parents rightfully feared that the child might not "come round." As soon as the child was stilled the serious situation disappeared,

the child lay breathing quietly, only the lightly sinking neck remained as a warning signal.

The attack reminds one of spasmodic croup. The obstacle to breathing was unwillingly sought for in the trachea. But in expiration was noticed what appeared to be a round tumor in the fossa above the sternum, the constricting thymus.

The described form of dyspnœa, the inspiratory stridor of nurslings, passes with the laryngologists and pediatricists as a harmless ephemeral malady.

There may be many cases, seemingly harmless, where such symptoms are outgrown, where pressing symptoms never appear. But such cases remain in the highest degree perturbing. Who can foretell the incalculable dangers which threaten the lives of such patients? Did not Avellis see a child of four quickly and unexpectedly strangle and has not Moritz Schmidt related how in one family he saw three children die of chronic stridor while a fourth was suffering from the same disease?

Our clinical experience suffices, the often described thymus death with its clear characters of suffocation suffices to prove that this narrowing of the trachea by a large thymus is a very insidious, dangerous predicament. In every case unusual watchfulness is demanded. Dyspnœa of any severity is the indication for immediate operation whose objective point is the gland; tracheotomy, whenever it has brought relief, has not been sufficient to prevent death. General anæsthesia is not necessary. By a median longitudinal incision in the neck one reaches the pretracheal space by separating the sternohyoids. The capsule is recognized behind the manubrium which is extended with every expiration. The capsule is seized by hemostats (Péan's) and drawn out with moderate force. At times it is easy to do this and establish free breathing. At others the capsule must be at once divided. An extra-capsular extirpation is impracticable; the gland must be enucleated. In Purucker's and Ehrhardt's cases a large part of the

organ could be so removed. The latter speaks of a total removal: such is hardly possible. Kœnig resected a piece. Even so much Rehn could not easily do in his second case since the glandular tissue tore off and disappeared deep in the thorax on each inspiration. With each expiration a further piece was obtained and finally the organ was carefully lifted up by means of a dull curette. For the sake of drainage the capsule should always be sewed outside the wound. All operations have so far achieved a perfect result. Never has it been necessary to remove the manubrium. Only in the rarest exceptions could that be necessary. In general this operation is a comparatively simple one.

As to the cases in which autopsy shows no narrowing of the air passages they may be classified as follows:

1. Those showing prodromal symptoms of stenosis.
2. Those in which there is not such prodromata, but which die under distinct symptoms of suffocation.
3. Those where death occurred unseen or instantaneous.

In the first two classes it seems that the thymus must be made responsible even if the later evidence of tracheal narrowing is wanting. The latter condition may depend on the manner in which the section is made; further, the narrowing may disappear at death. Both are quite possible.

The cases of the third class are doubtful in so far as they turn between death from heart failure and from complete closure of the wind-pipe, or whether there may have been any other cause of death. At any rate the indication to operate would be exactly the same whether the thymus hindered the air current or compromised the heart, directly or indirectly. But let us not deceive ourselves. The pathology of the thymus gland is as obscure as its physiology. A beginning has been made on its purely mechanical working. And how much waits on elucidation and explanation in this field! Purely hypothetical things like reflex effects from nervous disturbance and hyperthymæmia (Svehla) I have avoided. Also views of von Mikulicz on the influence of the

thymus juices on the thyroid. So much the more will we welcome thorough investigations in the field of physiology which would lead us to definite conclusions as to the purpose of the organ.

FRITZ KÖNIG said that he had operated twice in the last nine years on children with thymus compression. Both had attacks of inspiratory and expiratory stridor; the gland could be felt in the neck, and one developed a very convex vaulting of the upper thorax aperture.

For diagnosis other obstruction of the upper air passages must be excluded. Whether a real compression of the trachea or a compromise of the deeper lying nerves and vessels causes the symptom complex does not seem determinable in every case. In König's second case he found no improvement to follow resection and fixation of the left lobe and also deep tracheotomy; attacks continued. So he later removed the same lobe completely and enlarged the aperture of the thorax by resecting the sternum. There ensued a doubtful improvement and attacks have not yet reappeared.

König presented a nine-year-old boy on whom at three months of age he had partially resected the thymus and sewed it to the fascia. The improvement following the operation continued to recovery but immediately a severe rachitis developed so that the child did not learn to walk until he was four and a half.

This occurrence leads one to think of the relation which, according to Basch, may exist between the thymus and bone making. At any rate König holds it not justifiable (even when possible) to remove the entire gland; only partial removal should be done and eventual enlargement of the aperture of the thorax.

F. KRUMM had 11 years ago observed a case; a two year-old was afflicted with severe, gradually increasing dyspnoea, inspiratory and expiratory. Exact diagnosis was not possible and the following tracheotomy was without benefit. The next day's autopsy revealed a marked

enlargement of the gland which had developed mostly in the angle between the trachea and right bronchus, and here had caused a high grade of compression. Within the thymus was a lobular cavity which was filled with a yellow-gray, viscid, pus-like fluid. The process had nothing to do with real abscess formation or with syphilis as had been accepted, but certainly was an abnormal degenerative process. Mobilization was impossible because the large vessels ran for a distance in the thickened wall of the gland. Incision and drainage would certainly have saved the child.

V. Transplantation of Thyroid Tissue into the Spleen. PAYR (Graz).—A distinction must be made between functional and morphological transplantation.

About one-sixth of the animals in which the thyroid was completely removed and transplanted in whole or in part, survived without functional disablement, a striking result reached by no other experimenter. These successful results occurred in unbroken series. Many failures can be attributed to technical faults, to lack of the scrupulous care required by these animals in captivity and to many intercurrent maladies. Of those animals which did die from insufficient thyroid function only a few suffered from tetanus.

To add to the test many animals were kept in unheated rooms in winter and survived. All that were subjected to extirpation without transplantation died, usually with tetanic features.

Morphologically. The inserted piece is found to be reduced to one-fourth or one-third its original size, but the contrast between its color and texture and those of the spleen is marked. At times may be seen on the thyroid section surface brown pigment.

Microscopic examination shows that by Payr's method of transplantation the primary central necrobiosis is much less pronounced than usual, often entirely absent. Regeneration on the part of surviving grafts is very distinct.

The retention of colloid after long periods is very

variable; often, as found by other observers, it is very distinct, especially on the periphery, in other cases very slight but evenly distributed over the section. Many fields show after three to nine months the appearance in every particular of normal, colloid-forming thyroid tissue.

The difference in the results of different experimenters has been very great. Payr explains this by the varying physiological "gift" of each organ, those with "inner secretion" being naturally more adaptive to transplantation.

Since Kocher's advance in 1883 such transplantation has been done in man. The results were mostly negative, or transient when the first effects were even striking. Payr transplanted a piece of mother's thyroid into the spleen of a six-year-old child suffering from typical infantile myxedema. Three and a-half years of thorough thyroid treatment had been futile. The improvement during five months has been great both intellectually and bodily.

Incidentally these experiments teach some technique. The naturally copious bleeding from the spleen is at once stopped by the action of the inserted thymus tissue. The incision is then closed by sutures of fine silk reaching some way back. In this way and by adapting the pocket in size and shape to the graft bleeding was controlled in every case (and many of the dogs were large). In several cases magnesium was used in suture, in others a form of cobbler's stitch with omentum used as a living material to prevent cutting out. The first and simplest method generally sufficed, but with it the omentum was generally tacked to the suture line. The choice of the edge of the spleen for the pocket instead of the convexity facilitates the suturing and enables the stitches to be passed some way back, thus preventing tearing out. Payr accordingly points out that in the treatment of punctures and incisions of the spleen, similar suture may be quite suitable, while in rupture the usual extirpation should be adhered to.

Kocher said that he had had occasionally remarkable

results also, usually in the implantation between peritoneum and parietes. He has implanted all possible organs including veins, femoral artery, etc., but most of the subjects die. Lately is a new method in which very small pieces are implanted.

Payr replied that his extensive experiments lead him to doubt the value of small pieces, for in the act of detachments and transplantation a part of the graft always dies and the proportion of the surviving part to the whole graft is small.

VI. Experiments on the Infection and Bacterial Absorption of the Pleura. NOETZEL (Frankfort a. M.).—The frequent suppuration of the pleura after injury or operation has led to the presumption that, unlike the peritoneum, it has very slight power of resistance. These experiments show the contrary, that its natural powers of resistance are great, and greater than those of muscle and skin. This resistance (and power of absorption of bacteria) is broken, however, by the pneumothorax which so often accompanies injuries. Absorption was rapid, as it is through the peritoneum, and but five minutes sufficed after implantation of bacteria (pyocyaneus) to find them in the blood and internal organs. But this absorption is not the cause of the protection, any more than it is in the peritoneal cavity. That comes from the check the bacteria receive in these cavities directly through an immediate leucocyte-bearing exudate, the latter being later absorbed.

VII. On Gunshot-Wounds of the Heart. GOEBELL (Kiel) presented a young man upon whom he had operated for pressing symptoms one hour after the receipt of a 7 mm. shot through lung and heart. Goebell made a Wehr-Pagenstecher (osteoplastic) flap, found the lung apex perforated, and sutured it. From the wound in the pericardium blood flowed copiously. A furrowed wound was found on the left ventricle, entrance almost 2 cm. long, exit almost 3 cm. behind this of same length; 100 c.c. blood in pericardium. Entrance closed by four iodine

catgut sutures, the exit by five. Thereafter it still bled in a stream from a corner of one wound. This was stilled by one more suture, oblique and far-reaching. Suture of pericardium, pleura and the "double-door" flap. A thin drain was left twelve hours. After twenty-four hours the pneumothorax was aspirated. Now the patient is able to work and the heart is sound.

The diagnosis of lung and heart wounds at the same time is difficult. Goebell recommends that in cases of gunshot of this kind when the outlook is serious, to assure oneself whether the heart is wounded. If it is it must then be laid bare. In this way one can use the exploratory incision according to the direction and position of the bullet-tract. A fixed method is not to be recommended.

VIII. Suture of Heart-Wounds. WENDEL (Magdeburg). Since about 100 reported cases of injury of the heart treated by suture have given 44 per cent. of recoveries, the justification for operative treatment of such cases can no longer be opposed. As to the technique of the operation, however,—especially as to the method of exposing the heart,—views are still considerably at variance. The writer has successfully applied sutures in one case of perforating stab of the left ventricle, in a nineteen-year-old boy, and this not in an operating-room with all its favorable surroundings, but in the country, at the place where the wound was made, in the common room of a peasant's house, with the extremely poor light of lanterns and with very limited assistance. The operation was performed five hours after the injury. During four hours the wound had been imperilled by continuous explorations by the finger of the surgeon first consulted. The pleura was not injured. In consequence of this, the wound, enlarged by the first surgeon, and situated in the left intercostal space, did not admit of the proposed flap method for exposure of the heart. Instead, the wound was farther extended and as the injury to the heart was brought into view an irregular flap, with base below, was formed.

Most of the happy result in this case is to be referred to the lack of complication on the part of the lung and pleura. When, therefore, a typical method for the operation should generally be recommended, it should not be trans-pleural but extrapleural, and even also for those cases where the pleura is wounded. For almost half of the cases have been lost by septic infection passing from the opened pleura to the pericardium. It is therefore preferable, in cases where the pleura is wounded, after extrapleural exposure of the heart, to suture the edges of the pleura as well as the pericardium, and if an empyema follows to treat it, in the ordinary method, by resection of the ribs at the most dependent point behind. After consideration of the reported operations to be found, the writer therefore recommends Kocher's method, with the remark that generally a precise method is to be preferred.

IX. On Injuries of the Heart and Heart-Suture.

C. SULTAN (Leipsic) presented a patient who on the fifth day after a punctured wound of the chest, developed signs of hæmorrhage into the pericardium; collapse, increased area of dulness, soft murmurs. The pericardium was closed by suture except for the passage of a small drainage-tube. The pleura was not drained.

A second patient operated on by Sultan died forty-eight hours afterwards from a wounded and at first thrombosed internal mammary artery. The sutured wound was in this case, as in the preceding, situated in the left ventricle; the autopsy revealed besides a second puncture leading into the right ventricle and partially closed by a thrombus.

A preparation of the heart of this last case was presented; also a photograph of a heart the left ventricle of which was pierced by a sewing-needle, which was healed over. Another preparation was presented which was made from a man, fifty-three years old, who had jumped from a height and suffered such severe injuries that he died five days later. There was a long laceration in the pericardium

and the heart was wholly displaced into the pleural cavity.

Sultan considers the extrapleural operation to be but seldom applicable. Generally the pleura is wounded as well as the heart. Besides, the diagnosis of wound of the heart frequently cannot be positively made; we must often, upon beginning the operation, be satisfied that an intrathoracic hæmorrhage has taken place. Often the situation will be so serious that the surgeon must sacrifice the demand for a careful and methodic sparing of the pleura, to the rapidity of operation which is imperatively demanded.

BRACKEL (Libau) reported a case of injury to the region of the heart made by a splinter of granite, which was followed by purulent inflammation of the pericardium. The fragment of granite was removed from the pericardium, together with some fragments of clothing, and a tampon was placed upon a small laceration at the apex of the organ. The patient died of pneumonia fourteen days later.

BORCHARDT (Berlin) presented a boy in whom he had, some years before, sutured a penetrating wound of the heart.

JAFFÉ (Posen) agreed with Sultan, that during treatment of a punctured wound of the heart, at the opening of the pericardial sac, and on the introduction of the sutures, severe hæmorrhage may occur, so that the action of the heart, already embarrassed, may fail entirely. At such critical moments, according to the experience of the speaker, the following measure is of service, so long as the heart yet retains any vitality: The suture being rapidly made, by means of a Pravaz syringe the left ventricle is filled with the physiological salt solution; the no-longer-beating heart immediately resumes its action.

ZAWADZKI (Warsaw) recounted the history of a young man, nineteen years old, who received two wounds from a revolver fired at close distance. One was in the left forearm, a second in the fourth intercostal space, between the left edge of the sternum and the left mammary line.

No wound of exit. He saw the patient a few minutes after the injury. He did not complain, was pale, but pulse regular. After temporary dressing he ordered the patient taken to the hospital, which could only be done after two hours. On reception the patient was somewhat pale, pulse regular, but rapid—120. By the Röntgen rays there was plainly seen upon the screen a dark shadow in the region of the heart which exceeded in diameter an ordinary revolver ball. During the night and the following day the patient was feeling very well, no effusion of blood into the pericardium or pleura, no hæmoptysis. In spite of orders the injured man walked about the ward. After fourteen days two Röntgen examinations were made, one of the breast, the other in the dorsal position. In the first was seen two small projectiles lying close together, and at the second one also saw the two bodies, but much larger. Since the distance of the tubes from the plate in both examinations was about 45 cm., it was thought that the ball was situated nearer the pectoral surface. In view of the existence of but a single wound it was singular that at both examinations two projectiles (bodies?) were seen. Since it was impossible to assume that two balls could enter through a single external opening, they thought they were justified in believing that there had been a splitting or division of the ball. Since the opening was quite small, the edges smooth and the pieces of ball lay close together it was concluded that the division of the ball must have taken place inside the body.

ABDOMEN AND ABDOMINAL ORGANS.

I. Tampon Drainage of Abdominal Cavity. DREESMANN (Cologne).—In view of the various disadvantages of the methods of drainage heretofore resorted to, Dreesmann advises the use of glass tubes, 1–4 cm. in diameter and 5–20 cm. long, which are closed below and have lateral openings not over 0.2 cm. in diameter. Tamponing and absorbing gauze is placed in the tube and changed

several times daily, without difficulty and without the slightest discomfort to the patient. Except that in the tube no gauze is introduced into the abdomen, unless it be in cases where a considerable hæmorrhage is anticipated. The method has been followed for three years past, and in cases of perityphlitic abscess, abscess in Douglas' cul-de-sac, after cholecystectomy and choledochotomy, resections of the stomach and colon. In a few cases—3 or 4 times in about two hundred cases—when the openings in the tube were too large, or the gauze was not sufficiently packed, granulations extruded through the openings. By rotatory movements the tube was easily removed; if necessary galvano-caustic destruction of the granulations under illumination, might be resorted to. Intestinal necrosis, which has been observed by others, did not occur. The tube should be stitched to the external parts. [The translator has had such tubes sixteen years, and they are now in his collection of curiosities.]

II. Technique of the Operation for Femoral Hernia.

SPRENGEL (Brunswick) proposes a new procedure in the treatment of certain femoral hernias in women; the operative closure of the internal ring of the femoral canal, made through the abdominal cavity. The operation consists of the following steps:

1. In the flat position with head lowered, free exposure of the sac by linear incision, opening and examination of the same, and clearing of impacted contents.

2. Transrectus laparotomy on the side of the hernia, damming back of the intestines and the organs of the lesser pelvis.

3. Introduction of a Mikulicz forceps through the femoral canal into the sac and invagination of the same into the abdominal cavity.

4. Firm rolling together of the sac and suturing of it over to the internal ring, together with pulling forwards and suturing of the round ligament of the uterus, lying in immediate neighborhood of the inguinal canal.

5. Closure of the abdominal incision and the linear one over the femoral canal.

Five cases, of which the largest standing was of ten months, gave a perfectly satisfactory result. In one of the cases there was double femoral hernia with beginning prolapsus uteri. The uterus could be considerably elevated by the above procedure.

This method is adapted according to Sprengel, not to small recent hernias, but to old ones of large size and to recurrent cases. It is apparently easier and less dangerous than complicated plastic methods.

III. Technique of the Radical Operation for Large Umbilical and Abdominal Hernias. E. GRASER (Erlangen.)—The problem of a good and lasting closure in the case of large hernias is a very difficult one. Even after carefully performed and successful operations, there follows often a relapse. The larger the hernia the smaller the chances of an enduring cure. Busse reckons, from the statistics of Eiselbergs, clinic at Königsberg in 1901, 43 per cent. of relapses. In large hernias the prospects of permanent cure are yet worse. Also, the numerous propositions for new methods and for modifications, everywhere made, speak loudly for the unreliability of the procedures heretofore adopted.

We are at present satisfied with the results obtained by our method of suture after laparotomy, application of sutures in layers with exact union of the fascia. Cases of umbilical hernia are generally more unfavorable on account of the tension of the abdominal wall often present, particularly in obese patients, and also on account of the lateral strain of the abdominal muscles, which endangers the cicatrix. An important advance was made in 1893 by Gersung. It consisted in freely exposing and sewing up the recti muscles. This is often however very difficult and the tension, in large hernias, a great obstacle.

The favorable results obtained by Pfannenstiel in reference to avoidance of cicatricial hernias of the abdomen

by means of his transverse discision of the fascia above the symphysis, brought him very near to this method of avoiding separation of recti. Following this suggestion Menge¹ operated upon some cases. At the conclusion of his communication he recommended a modification, that the anterior sheath of the rectus above all be saved from injury, and he advised incision of the posterior sheath, in order to be able to effect release and suture of the recti as high and as low as possible. Graser had performed this kind of operation four times in cases of large umbilical and abdominal hernias and can strongly recommend the method. The undertaking is a serious one; the operations lasted to three hours, the enormous wound surface exposed and the numerous imbedded sutures in the usually very adipose abdominal walls are a strenuous trial on asepsis; but the course of the cases and the result surpassed all expectations.

The principal incision is made transversely over the highest point of the abdominal tumor, its length varying from 35 to 50 cm.

The hernial sac is opened, adhesions of the intestine freed, the trimmed part of the sac brought to the hernial ring. Now a separation of the sheaths of the recti into an anterior and posterior flap is absolutely necessary, and since such a division in the region of the cicatrised hernial ring is very difficult to effect, the anterior sheath of the rectus is to be divided transversely as far as the external border of the rectus, often widely displaced laterally, and now the entire anterior aponeuritic flap is to be lifted up. Where a division (separation) is not possible, the commissure of the rectal sheath is to be split along the inner border; in doing this the operator must most carefully avoid injuring the anterior layer, and make the division rather towards the posterior layer. Above and below, where the recti approach each other but do not touch, a longitudinal incision is made, near the linea alba, so that the fibrous structure of this remains in contact, as a stiff ligamentous layer.

¹ Zentralblatt für Gyn., 1903.

After preparation of this flap, the peeling out of the rectus is to be effected, and in the most careful manner by the finger or by the Kocher goitre sound. The loosening must be very carefully made as well from the anterior as the posterior sheath, with preservation of the nerves. This is often very troublesome, but is successful with intelligence and saving care. Only when the loosening is completed can suture of the omentum be proceeded with, and best simultaneously with closure of the posterior sheath of the rectus. On account of the tension stay sutures are generally necessary. Above and below the union can only be made in vertical line on account of the linear incision; occasionally some transverse seams may be added to diminish the gaping.

Now follows, and likewise in vertical direction, the union of the rectus muscles by interrupted sutures, some of which are passed deeper; others above these draw the edges somewhat over each other. When the muscles are well isolated, this can be done without much tension, the muscular fibres bear this badly, especially as they are mostly atrophied. But really it is generally astonishing how well-preserved are the bellies of the muscles.

Now the edges of the anterior aponeurosis are trimmed and exactly joined by a right solid row of interrupted sutures (iodized silk or catgut). If there is a surplus (of tissue) one flap can be pushed under the other and thus the line of union doubled, as Mayo has taught.

A hand breadth of skin, together with adipose tissue, can generally be removed, in which case deep sutures must be passed through the adipose.

The fear that the anterior fascia may become necrotic is shown by experience to be groundless; also, that the remaining soft parts may not suffice for covering, by the result in this particularly difficult case. It might indeed be quite impossible to draw together the edges of the hernial ring, with inclusion of the recti muscles; but it is entirely different when the fascia and aponeurosis, thickened by chronic inflammation, are again unfolded.

Most careful attention was given to cessation of bleeding. A glass drainage-tube was only once introduced at the side; the cavity, however, is so large that little can be expected from a single drain. A sand-bag was continuously applied.

In view of the large eventration a course of preparation was followed for about four weeks. It consisted of rest in bed, moderate fluid diet, daily aloin evacuations, compression with heavy bags of shot, daily taxis; every symptom of bronchitis allayed; digitalis administered.

Until the occurrence of the first passage from the bowels the condition of the patient was most serious; after that occurred all anxiety disappeared. Healing of the wound was undisturbed.

The worst case presents now, after the lapse of a year, a most satisfactory condition. The last examination seems to give assurance that there will be no relapse. The operation is particularly to be recommended because it establishes a condition closely approaching the normal anatomical.

KAUSCH (Berlin) has applied a net of silver wire in two cases and had relapses. The stiff net was simply torn. In this case Kausch exposed the recti, united there vertically above and below and drew the hiatus together in star-form with bronze-wire cross-stitches.

SEEFISCH (Berlin) advised giving physostigmine to prevent meteorism after the operation.

HELLER (Stetten) likewise advised physostigmine.

SPRENGEL (Brunswick) had doubled the fibrous ring and thinks that no fibrous tissue should be sacrificed.

WULLSTEIN (Halle, S.) in experiment on the cadaver had drawn down the pectoralis major; had not done it on the subject, however, on account of disturbance of innervation. He had divided the one aponeurosis anteriorly, the other posteriorly, and then the flaps.

In this way the recti came well together.

GRASER warns against sutures through the recti with tension. The suture which is thrown around the recti is

to be unconditionally rejected. Kausch will certainly have relapses. So, also, Graser opposes all muscular plastic as useless.

IV. Operative Treatment of Ulcer of the Stomach.

KRÖNLEIN (Zurich).—It is established that a considerable number of cases are not to be cured through internal therapy and that the immediate favorable results are often disturbed later through reappearance of the symptoms or serious complications. Many of these are finally cured or improved by later operation. The direct mortality from operation has been much reduced and is now eight to ten per cent. The late results are most satisfactory, complete cures in 61 per cent. distinct improvement in 24 per cent.—that is, a distinct result after a year in 85 per cent. The late mortality is very slight, depending mostly on carcinomatous degeneration. The cure comes in part from cicatrization, in part from the reestablishment of proper motion and secretion. Dilatation retires rapidly. The normal secretion and acidity are rapidly reestablished.

If the acidity was normal it sinks after operation below normal and then recovers itself. If it was decreased, then it becomes after operation normal or increased. It is seldom unaffected or permanently lessened. Free HCl is generally present after operation, in small quantities as before; sometimes it is abolished to be later resumed; where there is none before it is generally discoverable after. Subnormal acidity and lack of HCl cannot be considered disadvantageous. They cause no discomfort and are caused by the freer drainage of the stomach. The reflux of bile in time disappears; of pancreatic juice is very rare.

Choice of operation.—The operative aim is not the excision of the ulcer but the restoration of normal function favorable to healing, this is best attained by posterior gastro-enterostomy. Results are startling and more so the greater the previous disturbance. It is of value also in hæmorrhage and callous ulcer.

The excision of the ulcer should be exceptional; be-

cause ulcer is often multiple, hard to find, and its excision sometimes difficult. If undertaken it must often be combined with gastro-enterostomy. Pyloroplasty has no more justification; resection of the pylorus for stenosis and ulcer only when cancer is suspected. Instead, gastro-enterostomy.

Indication for operation.—Stenosis of pylorus of every grade. Every case of gastrectasis and gastroptosis of distinct grade where internal treatment has proved indifferent. Slight but oft-repeated hæmorrhage. In fulminating hæmorrhage the risk of delay till recovery from the attack seems less than that of immediate interference. If immediate operation, gastro-enterostomy merely should be tried. [Many statistics follow.]

RYDYGIER pleaded earnestly for gastrectomy on the ground, that the resulting conditions were nearer normal. Only by removal of the ulcer can we have a lasting cure. Gastro-enterostomy provides favorable drainage only, gastrectomy adds elimination of the ulcer. If there are multiple ulcers at least the worst are removed, "callous ulcers," those which affect the outer walls most. Gastrectomy provides for the mixing of gall and pancreas in the proper place, thus avoiding peptic ulcers. Gastrectomy hastens and assumes the healing of callous ulcer. These are known to heal after gastro-enterostomy, but so is death from unhealed ulcer known to follow the same operation. One operator lost in fifteen months two patients from hæmorrhage and two from perforation, where the ulcer had been left. In two to five and one-half years after 33 gastro-enterostomies only nine remained cured! Statistics fail because if autopsy shows cancer the cases are counted with operations for cancer, whereas cancer is known to develop on ulcer after gastro-enterostomy. The operation is thus twice to blame, once because it has failed to cure and again because it has abetted carcinoma-ulcer.

The frequency of carcinoma-ulcer is five to thirty per cent. If we are to remove cancer at the earliest we can

accomplish it by adopting gastrectomy more frequently for ulcer. We know certainly when cancer has begun by its development into an ulcer. The immediate mortality is more than in gastro-enterostomy, but is now reduced in some clinics to three per cent. But it is less dangerous than cancer. Rydygier presents a case of resection done twenty-five years ago and still in good health.

KOCHER prefers the anterior gastro-enterostomy because it gives better results and is quicker.

KAUSCH first attempts pyloroplasty and if that is impossible then gastro-enterostomy.

KELLING prefers the posterior anastomosis with entero-anastomosis. Has had three deaths in 74 cases. Three-fourths were long cured. A portion had relapses, even serious bleeding, but the latter was more easily cured than before. When an ulcer does not heal spontaneously it is because of unfavorable situation near the pylorus, unsuitable floor (liver or pancreas) gastropotosis and constitutional causes. The first three are favorably influenced by operation.

KÜMMEL pointed to the importance of early full nourishment.

KÖRTE.—In perforation the prognosis is favorable if operated within twenty-four hours.

KATZENSTEIN.—The chemistry of the stomach is overlooked as a factor in gastro-enterostomy. Krönlein has observed the effect on the mechanism of the stomach before and after this operation, through stomach fistulas in dogs. After all sorts of anastomosis fluid from the jejunum was seen to flow into the stomach. This caused of course a disturbance, nervous-reflex as well as chemical. The fat is also digested somewhat in the stomach by the gall and pancreatic juice there. Indeed after gastro-enterostomy the stomach digests fat freely and Katzenstein can give his patients freely of mayonnaise, more than normal man can stand. On the other hand much albumen, which is easily digested in the normal stomach is disturbing to these

stomachs. Conclusions: 1. Gastro-enterostomy causes the ulcer to heal not by prompt emptying, for this may be no more prompt than in the normal stomach; much more from the reduction or disappearance of the formerly excessive HCl. 2. Recommends a preponderance of fats, cream, etc., in the earliest days. This neutralizes the bile and pancreatin, postoperative vomiting is¹ avoided, and the patient recovers rapidly because of the assimilation.

HANS LORENZ (Vienna) reporting Hochenegg's clinic, held resection, circular or segmentary, as rarely justified; and segmentary without at the same time an anastomosis with the bowel as inadequate. In resection one may overlook ulcers, but with anastomosis the stomach is placed in a condition to cure them. He avoids resection even for callous ulcers, unless these are torn during operation, and his results have been remarkable, the healing being anatomical and not clinical. He prefers the posterior operation by suture of the highest point of the jejunum in a direction so that the peristalsis corresponds. Thus is the vicious circle and peptic ulcer avoided.

GRASNER reported specimen of fatal hæmorrhage four years after a posterior anastomosis by the Murphy button. The orifice had contracted to the size of a lead-pencil.

Symptoms of pylorus stenosis may be very slight; retention and vomiting may wholly fail, and pain only be present.

He has abandoned the Murphy button because the saving in time is slight, narrowing follows and he has seen it cut through before adhesion. Pyloroplasty has been abandoned because operation must be repeated for renewed stenosis.

FIBICH presented experiments showing that gastro-enterostomy cured ulcers even when the blood-supply of the stomach was interfered with. Rapid drainage of the gastric juice did not explain the effects of gastro-enterostomy for removal of the gastric juice through a glass tube without

removing the liquified food had no effect on the artificial ulcer.

CLAIRMONT, speaking for Eiselberg's clinic, could not share Krönlein's very favorable opinion as to the late effects. His favorable late results were but 58 per cent.

Ulcers near the pylorus are benefitted more than those at a distance or on the lesser curvature. Attempts have been made to choose the operation according to the location of the ulcer. All plastic operations are rejected. Cases of perigastritic, where there is no gastric ulcer nor cholecystitis, come from duodenal ulcer. Of 172 ulcers 10 were of the duodenum.

BRAUN rejected resection.

NÖTZEL.—Of 13 perforations of the stomach, seven were healed, the earliest of course with the better results. The technic for perforation is excision, a threefold suture, thorough irrigation, tampon and counter drainage on both sides, even when no peritonitis. Most of the healed remained free from all annoyance and a late autopsy showed an ideal cicatrix.

BARTH.—If ulcer of the duodenum is near the pylorus its symptoms may be the same as stomach ulcer, or they may be confined to local pain, or pain near the spine. As most cases die from perforation or hæmorrhage nothing remains but to operate (gastro-enterostomy) in all doubtful cases.

BRODWITZ demonstrated a peptic ulcer which had followed a gastro-enterostomy done two years before for pylorus stenosis. Resection, and thereafter patient was kept on bismuth to prevent recurrence. In spite of this, recurrence five months later. For increasing discomfort, jejunostomy. Still no distinct improvement. It was now discovered that when nutriment entered the fistula it caused a free flow of gastric juice. It is then a mistake to expect jejunostomy to exclude stomach function. The cause of peptic ulcer lies in some unknown individual disposition.

V. On the Diagnosis of Hirschsprung's Disease (Dilatation of the Large Intestine?). NEUGEBAUER (Mährish-Ostrau).—Both examination and history permit the diagnosis to be made with the highest probability. The previous methods of examination, distention with gas and filling with bismuth are to be avoided, the first because it has caused serious elevation of the diaphragm, the second because of great accumulation of feces. The proposed method is simple, to introduce a spiral metal sound high in the bowel. In these two cases this was easy. It is then skiagraphed and can then be seen in its course to the right of the navel and then to the diaphragm with great distinctness, and left no doubt that one has to deal with an enormously dilated sigmoid. The fluoroscope suffices, and in this way certainty can be at once attained in doubtful cases. The possible course of the sound in normal cases to the ascending colon is extremely unlikely.

One child died of intestinal catarrh and the other was operated upon. There was no valve obstruction in either, and both showed dilatation of the transverse colon and sigmoid, one of the rectum also. In operating, the undilated point of the colon was joined to the rectum. This patient, who never had a natural stool, is entirely cured. The liver dulness is restored. The success of the anastomosis shows the absence of valve obstruction.

VI. On the Further Development of the Operation for High Cancer of the Rectum. KRASKE (Freiburg).—In the past laparotomy has been used as an aid when the approach from below has failed. Kraske proposes the combined operation to be planned deliberately, and begun with laparotomy. There is end to end anastomosis and preservation of the sphincter. The mortality is high, but this is explained by the fact that the operation is adopted for only the severest cases.

KÜMMEL.—When the growth is movable and not circular he stretches the sphincter and draws the growth through it. When higher he uses the parasacral or sacral

route. Still higher, laparotomy. The mesentery is tied off as high as the transverse colon, incision of peritoneum and clearing out of the fibrous tissue of the pelvis, then invagination (through the anus) or closing of the peritoneum and excision of the growth through a pararectal incision.

KOCHER believes that one must first decide if he is to do an upper or lower operation; the former when the growth lies wholly within the region of the abdomen; the sphincter can then be saved; the deeper cancers only from below. The more dangerous combined method only rarely. Once with a sure diagnosis of cancer he operated from below and found no cancer; from above and found a cancer of the colon which was pressed downward by feces.

REHN considers the combined method very dangerous. One should operate rapidly. The pressing end should be sewn in the wound in order to see if the circulation be restored (gangrene) and finish with a second sitting.

HANS LORENZ.—This method must be welcomed as a present advance when (1) it affords a means of extirpation otherwise impossible; (2) when it is less dangerous than that from below; (3) when it is easier, and (4) when more radical. None of these is reached by this method. Even the late results are not better. In man it is more difficult because of the smaller pelvis; in woman much easier, but exactly for this reason is the attack on a high cancer from below easier in her case. The opening of the abdomen is adopted only when a high ligature tears out, the vessel retracts, and uncontrollable hæmorrhage results. Thus teaches Hochenegg's great amount of rectal material.

Small single cancers of the rectum or sigmoid are symptomless and are not discovered until obstructive symptoms appear. They are then crowded down to within reach of the sacral route. The slightest loss of blood is of suspicious significance.

POPPERT.—The mortality is not influenced by the form of anastomosis nor by sacrificing the sphincter so much as has been supposed. Neither is the claim correct that

attempts at anastomosis are a mistake. He has few resulting fistulas. Gersuny's twisting of the gut or Witzel's muscular gluteal anus is a sorry substitute for the natural sphincter.

HACKENBRUCH recommends excision under spinal anæsthesia.

MEYER.—Chief danger is length of time. Depage does a resection of sacrum after Bardenheuer and draws the stump down without suture, in half an hour. In the prone (head down) position the region is most accessible, better to be seen, bleeding less, and narcosis good, a position to be recommended in all operations on these parts.

KÜSTER prefers operation in two sittings in all cases where possible, and often uses lumbar anæsthesia.

BRAUN for a cancer of the lowest colon had first made an artificial anus and then a resection by Murphy button.

SCHLANGE considers it very rare where one can not reach the growth from above alone or below alone. When it can be felt from below it can so be removed. He recommends the making of an artificial anus, not a fecal fistula, rather high, and eight to fourteen days later removes the growth. Thereby is the operation cleaner and the tumor more movable.

JAFFÉ.—As important as it is to retain the sphincter, it must not be forgotten that implantation recurrences are very apt to appear in the rectum; they prefer that field.

KÖNIG has abandoned this operation for cancer but considers it admirable for rectal syphilis which cannot otherwise be saved from fistula.

KRASKE.—The belief that the sphincter action was damaged in the sacral route was a mistake. The later closing of an artificial anus he found not so easy.

VII. On the Value of Excision of the Spleen in Banti's Disease (Enlargement of the Spleen with Sclerosis of the Splenic Vein, Anæmia, Ascites, Liver Cirrhosis). JAFFÉ (Posen).—It is important to remember that the spleen

enlargement precedes these other symptoms by some time. The ascites is an independent symptom and its removal is more than a symptomatic therapy but of much influence. The belief is growing that the liver cirrhosis is a sort of wandering of the disease, and also that the splenic enlargement and the ascites are not obstructive symptoms. A part of the enlargement is due to an active process in the spleen (and liver).

Jaffé operated in an advanced stage of enormous ascites where no improvement was expected and had exceptional results, possibly a cure. This, in spite of advanced liver cirrhosis proven at the operation. So in certain forms of liver cirrhosis splenectomy is to be used in combination with Talma's operation (sewing the omentum to the parietes). (The latter works more no doubt by influencing the serosa than by establishing collateral tracts.)

VIII. On Plastic Operations on the Gall Tract. VON STUBENRAUCH (Munich).—A man had suffered for a year from a bile fistula established for choledochusstenosis from chronic pancreatitis. The pancreatic swelling did not subside, so the fistula became permanent. A cystenterostomy or cystogastrostomy was not feasible, so Stubenrauch prepared a flap of sero-musculo-mucous tissue "with upper base cut from the pyloric portion of the stomach and duodenum. This was rotated 180° and the serous surface applied to the choledochus defect, the mucous membrane sewed to the mucous edge of the little gall-bladder, and finally the stomach and duodenum firmly sewed to the base of the flap, saving a little pucker for drainage." The patient is completely cured of complete fistula with hernia.

On animals he demonstrates similar procedures. They are to be employed where the typical operations are impossible.

IX. Cure of Pancreas Rupture. BLECHER (Brandenburg).—A man received a blow from a hoof on the stomach. The next day gradual loss of strength, pain

in epigastrium, much vomiting. On the fourth day much anæmia, no effusion in abdomen, no peritonitis, indistinct resistance in epigastrium, dulness size of silver dollar between colon and stomach. Diagnosis of circumscribed hæmorrhage from pancreas. On laparotomy a cavity with blood and clots was found behind the elevated colon. A tear in the back of the pancreas, which was tamponed. Sugar in the urine for three days. Finally, complete cure.

X. On the Cause of Death in Acute Pancreatitis. DOBERAUER (Prag).—Fat necrosis and a resulting soap-poisoning has heretofore been held as the cause of the frightfully sudden death. Doberauer cannot accept this, but believes death to be due to poisoning from a substance produced in the diseased (obstructed) organ. Fat necrosis is known to heal; and we often find on autopsy or in operation very little fat necrosis. Neither does Doberauer consider peritonitis a cause of death; lack of gross changes, and of bacteria in effusion, in necrosis and in pancreas. It takes longer to kill through septic process.

We must next take refuge in nervous reflex working through shock to the sympathetic. Rapid cases of such are known but they are then caused by severe mechanical insult to the peritoneum. The influence of the acute disease on the general condition, blood and urine, is not sufficient. Investigation of the latter shows it to be little disturbed.

In dogs the pancreas was doubly ligatured and divided with the production of a disease apparently identical with acute pancreatitis in man. If some of this pancreatic tissue was injected into the abdomens of other dogs the disease was reproduced. The injection of fresh and sterile tissue from pancreas not so affected did not affect the subjects. The obstructed pancreas were in no way necrotic, so the intoxication did not come from such source. Tissue from the ligatured spleen produced no effect. Animals immunized by repeated small injections from the mutilated pancreas were then able to withstand the operation of ligating the

pancreas! They were immune, not to pancreatic substance but to poison contained in the inflamed organ.

URINARY ORGANS.

I. Treatment of Intra-Peritoneal Bladder Tears without Bladder Suture. NEUMANN (Mainz).—The results in laparotomy and suture are not good. There is a growing suspicion that the peritonitis which causes death may be caused by operation. Neumann reports a case where suture had to be abandoned because of collapse and was replaced by a tampon the size of the fist. Twenty hours after some urine was passed naturally. Complete cure. The tampons must not be so large as to compromise the bladder.

EXTREMITIES.

I. Socket Resection in Hip-Joint Disease. BARDENHEUER (Cologne).—To determine the condition of the socket he palpates by finger the inner surface of the pelvis, lifting up the psoas. It is usually found to be diseased because of the lateness of the operation and its resection or curettage shortens much the convalescence. It also enables one to reach all the tuberculous tissue. The real shortening is slight and is compensated in the inclination of the pelvis and the abduction of the femur.

The fourth advantage is that the operation prevents the development of adduction-flexion and the wandering of the femur head past the pelvis.

The fifth, that there usually forms a strong movable union (twice in seven a bony union).

Sixth, good function. The dangers are not greater, and when we consider the lamentable results of the incomplete operation, really less. Of course resection of the socket is combined with excision of the head of the femur, etc.

SPRENGEL has repeatedly used this method (Bardenheuer's), but he does not go so far as Bardenheuer, who attacks the socket in relatively early cases. The attack is

too severe. It should be reserved for late cases and the young, not for the old.

II. On the Voluntary Luxation of the Hip-Joint. BRAUN (Göttingen).—Only twenty cases have been reported and this the first operative. The girl can dislocate the hip partly voluntarily by straining certain muscles, or in walking it may occur spontaneously. The luxation is incomplete and outward, and is accompanied by a loud crack and great pain. The unbearable trouble was operated upon after rest, extension and gypsum failed. No cartilaginous antrum was found, leaving the socket shallow. A piece 2 by 5 or 6 cm. was chiselled from the upper hinder edge of the bony socket, displaced downward, and fixed. Plaster of Paris dressing. Primary union. Complete cure after two and one-quarter years. The method is recommended for repeated spontaneous luxation when depending on similar basis.

III. On the Fate of Silver Wire in Open Suture of the Broken Patella. VON BRUNS (Tübingen).—Of twelve cases, in only one was bony union reached without tearing out or breaking. In three cases pieces of wire reached the capsule. Bony union occurred in three cases, but in two more Röntgen examination showed slight separation. The harm from the wire does not reach to compromising the healing. Patients frequently complained of sticking pain. Complete extension usually followed.

KRÖNLEIN is not convinced that the open method is better than the closed.

KÜSTER recommended the percutaneous suture.

RIEDEL recommended the subcutaneous suture with catgut, and with 10 to 12 such the fragments could be very closely lashed together.

VON BRUNS is not satisfied with the results. A good anatomical healing is not identical with good functional cure, and the converse.

BARDENHEUER obtains by extension at least a good fibrous union.

IV. On Bone Implantation. RAUSCH (Schoneberg) demonstrated the largest (up to this time) piece of dead bone implanted in bone and healed. A piece 9 cm. long and the thickness of the whole tibia was obtained from an amputation the day before, boiled and placed in the upper end of the tibia which had been resected for myelogenous sarcoma. Secured to femur and tibia by ivory pegs. Primary union. Nine months later, amputation for recurrence.

The implanted piece had grown fast on both sides, was nourished and covered by new periosteum.

V. On the Rational Ambulant Treatment of Varicose Veins and Ulcers of the Leg. LOSSEN (Frankfort a. M.).—The cause was mostly in the inactivity or weakness of the musculature of the lower extremity. Previous forms of treatment have at most only a temporary result and instead of considering this chief cause one still prescribes rest and elevation. The trouble quickly returns. Instead of weakening still more the musculature through disuse it should be put in condition again by gymnastics, massage, etc. Lossen has treated several smiths without interrupting their work, by showing them ten to twenty times how to do during their work the required gymnastics. After four to six weeks the swelling was gone and the ulcers healed. He has also had good results in the *praxis elegans*.

VI. Osteoplastic Resection of the Tibia and Ankle-Joint. BRODNITZ (Frankfort a. M.).—Adaptable to advanced tuberculosis of the lower third of the tibia and ankle-joint, especially tumors of the lower third of the tibia. Longitudinal incision over tibia and over fibula to the talonavicular joint; connecting the upper ends of these by a bow-shaped incision down to the bones, and the lower ends by an oval incision over the tuberosity of the calcaneus, also to the bones. Oblique division of tibia and fibula by Gigli saw and the calcaneus by a metacarpal saw, the soft parts correspondingly. Shell out the anterior soft parts and adapt the calcaneus to the tibia.

VII. On the Plastic Covering of Exarticulation Stumps. SAMTER (Königsberg i. Pr.).—Both feet of a child were crushed, the soft parts above the malleoli. The malleoli were sawed off, a bridge-shaped flap was made from behind the lower end of the tibia and slid down under the defect like a stirrup. The rest healed by granulation. The result for some time has been good, movable soft parts and a supportive stump.

BOOK REVIEWS.

A TEXT-BOOK OF THE DISEASES OF THE EAR, NOSE AND PHARYNX. By D. B. ST. JOHN ROOSA and BEAMAN DOUGLASS. New York: The Macmillan Company.

This little book is a sort of First Reader on the subject. It is an example of conservative teaching except in one or two places where it seems to buck over the traces to an astounding degree; *e. g.*, "If the bony wall of the sinus is removed, and the membranous wall exposed, no harm results. In fact, this should always be done in order to obtain information about the condition of the interior of the sinus,"—p. 485.

Certain statements should certainly *not* be accepted as true by beginners without personal investigation; *e. g.*, "Its actual value (that of the tuning-fork) in testing the hearing power is chiefly with one tuning-fork, C₂,"—p. 4; "The observer does not look through the opening in the mirror but rather over the rim of it,"—p. 10; "More dependence can be placed upon the appearance of the drum-head and the sensations of the patient than upon the sounds heard through the diagnostic tube,"—p. 37. Later in the book non-dependence on the appearance of the drum-head is especially emphasized; that poulticing is good treatment in either external or middle otitis; "no nasal-spur operation should be left without packing the nasal cavity,"—p. 233; "The best method of treatment is undoubtedly amputation,"—p. 277, for hypertrophy of the faucial tonsil (does not even mention enucleation); in speaking of paracentesis of the drum-head: "The operation when required causes so little pain,"—p. 294; "The diagnostic tube could well be dispensed with in aural practice,"—p. 365; "But the piston syringe, made of metal, is the preferable one for the purpose of removing pus from the ear,"—p. 404; "Fever is present throughout the entire course of mastoid disease,"—p. 462; the description of an operation of opening the mastoid cells without extending the field to the mastoid antrum, p. 475; the recommendation of the use of the

trephine or drill in certain cases of operation on the mastoid, p. 477; the use of the Stacke protector, p. 481.

Certain portions of the book are to be unreservedly commended; such as the description of the causation of the ill-effects constitutionally of mouth breathing, pp. 204-5; the rules for the method of using the nasal douche; the emphasis laid upon the necessity for frequent attention, even daily, by the surgeon in cases of chronic middle-ear suppuration, p. 404.

HENRY A. ALDERTON.

The PRACTICE of GYNÆCOLOGY by EMINENT AUTHORITIES.
Edited by J. WESLEY BOVÉE, M.D., Professor of Gynæcology in George Washington University, Washington, D. C.
Octavo, 838 pages. Philadelphia and New York: Lea Brothers & Co., Publishers. 1906.

This work is the first of three companion volumes dealing respectively with Gynæcology, Obstetrics and Pediatrics, and is offered to the profession as a practical treatise on the diseases of the generative organs of women and on those of the neighboring organs, the urinary system and rectum. The work has been written by seven contributors.

J. Wesley Bovée has written the chapters on the Developmental Anomalies of the Female Generative Organs, Sterility, Diseases of the Rectum, Anus and the Urinary Tract; J. Riddle Goffe, Menstruation, Displacements of the Uterus, The Vaginal Method of Operating, and the After Treatment and Complications of Abdominal Operations; G. Brown Miller, Uterine Conditions; George H. Noble, Fistulæ, Lacerations of the Perineum and Diseases of the Vulva and Vagina; Benjamin R. Schanck, Diseases of the Tubes and Ovaries exclusive of Infections and Tubal Pregnancy; Thomas J. Watkins, Infections of the Tubes and Ovaries; X. O. Werder, The Examination of Pelvic Contents, The Technique of Abdominal Operations and Extrauterine Pregnancy.

Pathology and bacteriology have been chosen as the chief guides in the classifications of diseases. The classification of endometritis by Miller on this basis seems most rational. He regards only those cases which show actual inflammation as endometritis and does not apply the term loosely to the hypertro-

phies and other changes in the endometrium due to misplacements, pelvic tumors, etc. As bacteria are the cause of uterine inflammation in the vast majority of the instances, he considers endometritis and metritis as some stage of infection, either acute or chronic. He therefore classifies them according to the various agents infecting the genital tract: (1) gonorrhœal, (2) those conditions caused by pyogenic or saprophytic bacteria (essentially a wound infection), and (3) tuberculosis.

The feature which particularly recommends the book is that the latest ideas in each branch of the subject are presented as exhaustively as the scope of the work permits by one especially interested in that branch.

JOHN A. SAMPSON.

A TREATISE ON SURGERY. By GEORGE RYERSON FOWLER, M.D., Brooklyn, New York City, Examiner in Surgery, Board of Medical Examiners of the Regents of the University of the State of New York, etc. 2 vols., royal 8vo. Philadelphia and London: W. B. Saunders Company, 1906.

There are two points of view from which we may regard a new treatise on surgery. It is the record and exposition of the learning of the author and his ability as a teacher, but it is also a history of his own achievements in his chosen work and a record of what he himself has done to further the science and art of surgery.

The author of this treatise has finished his work. He has laid down pen and scalpel and sleeps in his final repose under the greensward on the edge of the busy city whose people he served so well. He never saw a printed copy of his book. Death overtook him almost at the desk, as his hand wrote the finishing lines of his last work, and seizing his pen wrote for him on the clear record of his life, "Finis." And so he slept.

Dr. Fowler's habit of thought, his incessant and superabundant energy which drove him to work, as Jehu drove, furiously, unfitted him for the cloistered recesses of the laboratory and the quiet routine of research work. His nature kept him on the firing line, in immediate conflict with the forces of disease, so he sought out for his life task the most exacting and exhausting work of the profession, the practice of surgery. When he was not actually at work over the operating-table, he was at his desk, and

when he was not at work he was asleep. It was impossible for his restless mind to be idle. His treatise on surgery is his gift to the profession, his farewell and his monument.

As we glance through the pages of the work we are constantly reminded of the man. Dr. Fowler was a student of the world. No pent up Utica restrained his powers or activities. He was not satisfied with the literature of his native tongue nor with such reading as his limited time allowed him from the world's literature, so he kept himself informed through correspondents in Europe whom he paid to forward to him at once everything of importance which went on in the European clinics. He was thus often cognizant of continental methods long before the published accounts appeared in the journals. He was also a familiar figure at most of the great clinics abroad, whither he journeyed not for rest but rather instruction and the amplification of his powers. As a teacher his years of experience fitted him in a peculiar manner to write a successful work on surgery. He knew wherein men failed. He had probed the weaknesses of the graduate student for many years, nor had he read hundreds of examination papers without appreciating the value of conciseness and exact statement. His book is the epitome of his life. No one can peruse its pages without being impressed with the wide learning of the author. It has become fashionable nowadays to edit a work on medicine or surgery in which the work of the editor is largely that of supervision, the successive chapters being written by different men. Such works are termed "Systems," and are often notable for the unevenness of their quality. Dr. Fowler however has put into these pages the record of his life of work and study with little aid from other men. It is distinctly Fowler's Surgery and not an edited compilation. The work is a marvel of condensation. There is little rhetoric and no useless verbiage. Every sentence tells its story, either to recount a fact or give instruction as to treatment. The first volume, as the author states in his preface, contains an exposition of the "fundamental principles underlying what is known as the science of surgery." Chapters on inflammation coupled with a chapter on surgical bacteriology give the student the basic facts which relate to acute and chronic tissue changes dependent on the various infections. The chapter on laboratory aids to surgical diagnosis is invaluable and contains the most recent

methods in hæmatology, urinology and kindred subjects. Chapters on general surgical considerations, common and special dangers incident to operations and postoperative complications point out to the student the various pitfalls and snares in surgical work. The chapter on operative procedures is an epitome of operative surgery. A chapter on the regional surgery of the head and thorax concludes the first volume. Of special interest is Dr. Fowler's account of total pleurectomy, an operation which he originated and first performed October 27, 1893. The second volume largely contains the results of the author's personal work, and consists in a description of the regional surgery of the body with the exception of the chapter in the first volume already noted.

Among operations which Dr. Fowler originated or modified may be mentioned the following: Protopexy, for total prolapse of the rectum; ventrosuspension of the uterus by means of the urachus; a combined catgut and cautery operation for hemorrhoids; intraperitoneal displacement of the cord, a modification of the Bassini operation for hernia; ureterorectal transplantation of the ureters for exstrophy of the bladder with valve formation to prevent ascending infection. The chapter on hernia is of great excellence. The chapter on the surgery of the prostate contains an account of all the more recent work which has been done in this important field. The chapter on operations on the pelvic organs is as complete as considerations of space permit in a two-volume work. The volume closes with the injuries and diseases of the extremities, including fractures and dislocations. The author devoted most of his spare time for the last fifteen years of his life to the completion of this work. It is his book, the record of his experience, a summary of his life work. Those of us whose privilege it was to be his associates will ever read its pages with affection and respect. We shall be reminded of his eagerness for work, of his boyish enthusiasm, his pleasure and happiness in the success of his own pupils and former assistants. He had no mean jealousies. He was always ready with advice, congratulation, encouragement. We have lost our master and our friend.

ALGERNON THOMAS BRISTOW.

CARR'S PEDIATRICS. THE PRACTICE OF PEDIATRICS BY EMINENT AUTHORITIES. Edited by WALTER LESTER CARR, M.D. Octavo, 1014 pages. Philadelphia and New York: Lea Brothers & Co. 1906.

The Practitioner's Library, published by Lea Brothers & Co., is composed of three companion volumes covering, respectively, Gynecology, Obstetrics, and Pediatrics, each edited by a clinician and teacher of wide experience, bringing together in three volumes the opinions of well-known authorities in America and England upon selected subjects assigned to them by the editor.

In the volume on Pediatrics, the author gives his own observations of a disease and the therapeutic measures which have resulted in the greatest success, giving to each contribution a personal element which is of great value to the reader. All of the writers emphasize first the clinical picture of the disease and then the best method of treatment.

The treatise is illustrated throughout by most excellent colored plates and photographs, and the subject matter is so arranged as to make any special subject readily accessible to the reader. Historical digressions and discussions of unproven theories have fortunately been omitted. Pathology has been somewhat slighted in order to give more prominence to symptomatology and treatment. Considerable space is allotted to infant feeding, diseases of the alimentary tract, disorders of nutrition, respiration and circulation, emphasizing those conditions associated with disease in children.

The work is divided into twelve sections: Section I, Diseases and Injuries of the New-Born, by Edward P. Davis, M.D.; Section II, Development, Growth and Hygiene, by Leroy M. Yale, M.D.; Section III, Infant Feeding, by Thomas S. Southworth; the remaining sections treat separately of the diseases of the various tissues and organs of the body. The section on the Diseases of the Alimentary Tract, by David Bovaird, is especially commendable. The section on Infectious Diseases is divided among a number of eminent authorities.

The book, as a guide to the practitioner, is most satisfactory, and throughout is a clear and practical treatise on Pediatrics.

PAUL PILCHER.

CORRESPONDENCE.

REMARK UPON THE ARTICLE OF DR. CARLETON P. FLINT: "A NEW METHOD OF EXCISION OF THE KNEE WITHOUT OPENING THE JOINT," IN THE ANNALS OF SURGERY, MARCH, 1906.

EDITOR ANNALS OF SURGERY:

The "new" method described in the article mentioned in the title, in respect to its technical execution apart from single details as well as the aim which the author intends to reach, is essentially the same extracapsular method (extracapsuläre Methode) which I proposed long ago.

I gave the description of this method first in Russian, in the journal *Wratch*, 1896, No. 31, in an article entitled "So-called Extracapsular Method of the Excision of the Knee, and lately, in the year 1904, in the *Deutsche Zeitschrift für Chirurgie*, bd. 74, in the article "Zur Frage der operativen Behandlung der Tuberculose der grossen Gelenke der Extremitäten und speciell der Resection derselben." To this last treatise, which shows at the same time that the extracapsular excision is also applicable to other joints in case of tuberculosis, I refer Dr. Flint in order to acquaint him with my opinion on this question.

In general, I can only greet with pleasure the further appearance of a completely independent proposal of the extracapsular excision of the joint (resp., without opening it) as the best proof of the inexpediency—at least in many cases—of the usually employed innerjoint excision, which reveals itself more and more.

NICHOLAS WALKOWITCH,
Professor of Surgery at Kiew, Russia.

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ORIGINAL MEMOIRS.

THE QUESTION OF EARLY OPERATION IN CASES OF INTRACRANIAL INJURY.

BY CHARLES PHELPS, M.D.,

OF NEW YORK,

Surgeon to St. Vincent's Hospital and Consulting Surgeon to Bellevue Hospital.

IT is evident from cases and observations published from time to time, that the question of operative interference for intracranial injuries has not always been considered with due regard to the probable nature of the lesion. Since, in a large proportion of cases, unwarranted and ill-advised interference may lead directly to a fatal result, the most accurate obtainable knowledge possible of what is to be encountered in a prospective operation and the most exact appreciation of just what it may be expected to accomplish would seem to be essential; while in fact, a more or less prolonged period of unconsciousness has apparently been too often regarded as the sole and sufficient reason for entering the cranial cavity.

The value of a condition of unconsciousness, both as a diagnostic sign and as an indication for operation in certain cases, cannot be overestimated, provided the earlier history of the case can be obtained and verified. Unfortunately it often happens that such a history will be found to be entirely lacking, or to be dependent upon obviously unreliable evidence.

For example, in forty per cent. of a recent series of 50 cases, no information as to the primary mental state was obtained, and in many others it was known to the ambulance surgeon only from the unsubstantiated statements of casual witnesses.

The simple fact that unconsciousness exists, independent of the time of its occurrence and of its relation to concomitant symptoms, is in no sense diagnostic, since it occurs equally in any form of intracranial hæmorrhage—epidural, pial, cortical, or subcortical, or with a general cerebral contusion, with or without cerebral laceration.

The symptom of greatest importance to be studied in connection with unconsciousness, and which may be regarded as in some sort the key to its interpretation, is temperature. The writer is unable to better express his views as to the relation of temperature to unconsciousness, than by quoting from what he has written on a previous occasion.¹

The loss of consciousness, which immediately succeeds a cephalic injury, is always the result of diffuse cerebral contusion; if unconsciousness is preceded by a conscious interval, however brief, or if after restoration of consciousness its privation soon recurs, it is occasioned by some form of intracranial hæmorrhage. If, however, primary unconsciousness is permanent or greatly prolonged, its continuance may be due either to the severity of cerebral lesion or to a complicating hæmorrhage; and whether the one has persisted from the beginning or been at any time replaced by the other, or whether both exist together, can be determined, if at all, only by a study of all the symptoms presented. The pulse, temperature, and respiration must be systematically recorded in every case from the first opportunity afforded for observation until the end. . . . of these, the temperature in its course and variations will afford in the greater number of cases the most distinctive indication of the nature of the lesion. . . . If, then, after the lapse of hours consciousness still remains in abeyance, a stationary temperature, but one or two degrees above the normal standard, will indicate a hæmorrhage of some profusion without serious cerebral injury; but a higher elevation which constantly increases, with possible recessions, will point to a visceral lesion. . . . The cases in which consciousness after brief restoration is again lost permanently, or for a lengthened period, have the same relations to temperature as those in which unconsciousness has been uninterrupted. It will be recalled that the recurrence of unconsciousness after an early interval of sensibility is indicative of an increase or supervention of hæmorrhage, and that at a later period more or less conscious intervals in a general uncon-

scious condition result from a lessening from time to time of the hyperæmia or œdema of a diffuse cerebral contusion. The question of hæmorrhage should scarcely arise in the last instance, but the temperature still conforms to the general rule.

It is beyond the scope of this paper to enter into the detail of symptomatology except in so far as it may be essential to its main purpose—to indicate the surgical necessity of reaching, if not a positive, at least a reasonable conjectural diagnosis, and of being guided by it in determining the advisability of operative intervention.

The basic distinction to be made is between lesions as they occur above or below the dura mater. There ought to be no longer question as to the propriety of exploring fractures of the cranial vault by incision of the soft parts if they are not already compound, and by elevation of bone, if it be depressed. The recognition of a certain number of epidural hæmorrhages, is thus incidentally determined without the necessity of further consideration. If the fracture is merely linear, an epidural hæmorrhage, or other as yet undetermined lesion, must be relegated to the class of intracranial injuries in which the fracture is confined to the cranial base, or in which there is no cranial implication.

As hæmorrhage is the only epidural lesion so contusion in some form—meningeal or cerebral, limited or diffuse—may be said to be the only result of trauma, as it affects the structures below the dural membrane. Meningeal contusion occasions primarily hæmorrhages or serous effusions into or beneath the pia mater, and, secondarily, arachnitis, which by some surgeons has also been included within the sphere of operation. Cerebral contusion is manifested by hyperæmia, with thromboses of its minute vessels and capillary hæmorrhages, and by œdema. These several expressions of meningeal and cerebral injury may be limited or diffuse. General hyperæmia and œdema may be equally well marked as disclosed by post-mortem inspection, but oftener coëxist in inverse proportion. A superficial laceration with cortical hæmorrhage may be an accompaniment of cerebral contusion; or a secondary subcor-

tical laceration may result from fusion of capillary hæmorrhages, with gradual disintegration of tissue, or from a sudden and extensive destruction of cerebral areas due to ruptures of larger vessels, which have been undermined.

The subdivision of subdural lesions into meningeal and cerebral is important. The meningeal contusion is intermediate between the epidural and cerebral lesions, not only topographically, but in symptomatology and diagnosis; and if operation be proposed, in prognosis. The interstitial minute hæmorrhages and slight serous effusion may be neglected in this connection, since they are unrecognizable, and only material as they may lead to later local or general inflammation. The free hæmorrhage or serous effusion, however, which occupies the subarachnoid space may have direct symptoms which, if little complicated by those of concurrent injury of the brain itself, may be intelligible in exceptional cases. The hæmorrhage when too large to remain confined in the pial meshes, will still probably be in small amount and spread in a thin sheet, or in scattered patches, over some larger or smaller area of the pial surface, and complicated by cerebral lesions, which afford the dominant symptoms. In exceptional cases only will it be sufficiently large to produce paramount symptoms of hæmorrhage, or so concentrated as to occasion focal disturbances.

The frequency of occurrence of epidural hæmorrhage and of these other comparatively superficial lesions and the possibility of distinguishing them from each other, can only be estimated by statistical inquiry. In a series of personal observations of intracranial traumatism first published in 1897,² it was found that among those subjected to post-mortem examination, 173 were of fractured base, or were without cranial implication. If to these are added twenty-seven others of the same classes from an unpublished series of 1904-5, the total of 200 will form a convenient and sufficient number for comparative study. Cases of gunshot and vertex fractures are excluded for obvious reasons.

In thirty-four of these cases epidural hæmorrhage was the dominant, or at least the most prominent lesion, as was pial

hæmorrhage in thirty-seven others. Epidural hæmorrhage occurred with fracture of the cranial base in 31 out of 148 cases, about twenty per cent.; and in 3 cases, somewhat less than six per cent., in 52 cases without such fracture. Pial hæmorrhage coëxisted with fracture of the cranial base in 21 out of 148 cases, a little more than fourteen per cent., and in 16 out of 52 cases, or nearly thirty-one per cent., of the cases of simple intracranial injury. If the case, therefore, be one in which cranial fracture may be excluded, it is probable in the proportion of six to one that the hæmorrhage is subdural, and if indications of cerebral lesion are not prominent that it is pial, rather than cortical.

The comparison of symptoms of these two forms of hæmorrhage, epidural and pial, will indicate statistical rather than pathognomonic differences. The opinion already expressed as to the impossibility of distinguishing one from the other is confirmed by such an examination.

The mental condition in the cases of epidural hæmorrhage varied: In 27, consciousness was lost at the earliest observation made: in 4 it was secondarily lost, and in 3 it was retained until the close of life. In 1 delirium was primary and permanent; and in another it followed a fifteen minutes' interval of primary consciousness. In the cases of pial hæmorrhage, consciousness was lost primarily in 28; and secondarily in 9, of which 2 were walking cases, and 2 were primarily delirious.

Both pupils were dilated in 7 of 30 cases of epidural hæmorrhage, and a single pupil was dilated in 11. In 5 cases one or both pupils were contracted; in 4 they were unsymmetrically abnormal, and in 3 they were normal. In the 11 cases in which a single pupil was dilated the hæmorrhage was on the same side of the cranial cavity in 9, as it was in all the 4 cases of unsymmetrical abnormality; it occupied the middle basic fossa of the same side in 3, and the opposite middle fossa in 2. In 27 cases of pial hæmorrhage, both pupils were dilated in 12, and a single pupil was dilated in 3; in 3 cases both pupils were contracted; in 1 case they were unsymmetrically abnormal; and in 7 they were normal. In the 3 cases in which a

single pupil was dilated, hæmorrhage was on the same side in all, but in 2 of them it was on both sides, as it was in the cases of unsymmetrical abnormality. In 2 cases in which hæmorrhage occupied a middle fossa, the pupils were normal in 1, and were both dilated in the other.

The pulse and respiration show no distinctive differences in the two forms of hæmorrhage, except that the average pulse was less frequent in pial hæmorrhage, on account, perhaps, of the more usual cerebral complication. The asymmetry of the radial pulse at the two wrists in a certain number of cases was common to all forms of intracranial injury. The respiration was not notably disturbed in either case until towards the close of life.

The focal symptoms of practical importance were disorders of the muscular system and occurred with equal frequency, whether or not the dural membrane intervened to protect the motor area. They were: paralyse, paresis, and local or general convulsions, muscular twitchings and rigidity. Some one or more of these were present in 22 cases, and with the exception of convulsions, occurred indifferently with either pial or epidural lesions. Convulsions were confined to cases of pial hæmorrhage, and in each instance were associated with cerebral laceration. The extreme infrequency of respiration noted in compression of the respiratory center by clot in pial or cortical hæmorrhage, and the cyanosis and pulmonary œdema which may characterize an epidural hæmorrhage involving a posterior basic fossa, are both focal and diagnostic symptoms, but without further significance, as they occur only in cases in which interference is not to be considered.

It follows from this view of symptoms that these two forms of hæmorrhage are indistinguishable from each other, while the cranial wall remains intact. Certain inferences may be derived from probabilities, the strongest of which is based upon the presence or absence of fracture, and the presence or absence of cerebral contusion. Consciousness is lost in the great majority of cases of either one; delirium is exceptional in either and is never occasioned by the hæmorrhage; pulse and respiration,

as well as focal symptoms, are not distinctive, the results of lumbar puncture are the same, and temperature in both depends upon complications. The pupils, both singly and symmetrically, are much more frequently dilated in pial than in epidural hæmorrhage; but so often in the latter that no useful inference can be drawn from their condition. In short, a hæmorrhage is a hæmorrhage wherever it is situated, and its location can only be indirectly established, if at all, whether it be pial, epidural, or cortical.

A subarachnoid serous effusion in considerable amount and distinguishable from an inflammatory product, usually general, but sometimes localized, was disclosed in fifteen cases. Cerebral lesions were well marked in all, as would seem to be inevitable since a meningeal contusion so severe could hardly fail to extend to the brain beneath. Direct symptoms might be expected to be recognizable only when the cerebral complication was comparatively unimportant, which was not the fact in either of these cases. Under what circumstances such a serous accumulation might reasonably be expected to exist may be better considered after some reference to the indications of brain injuries.

The symptoms referable to lesions of the brain itself, which in some aggregation characterize all cases of intracranial injury, may be briefly enumerated as disorders of the mind, pulse, temperature and respiration, muscular system, sensation, loss of urinary and fecal control, and occasionally disorders of the special senses. To these are to be added variations in the size and reactions of the pupils.

Intracranial injuries are always complex, but their component lesions usually differ so greatly in extent that only a single one may be of practical importance in diagnosis or in treatment. So many symptoms are common to two or more of these lesions that the determination of the one which is paramount must depend largely upon the study of symptoms collectively and in their mutual relations.

In this connection some points in symptomatology and diagnosis are pertinent to a later consideration of treatment.

The loss of consciousness is common to all forms of intracranial injury. It is, moreover, the only mental defect which directly results from either of the superficial hæmorrhages. Its relations to diagnosis in the matter of time of occurrence and temperatures, upon which its significance depends, have been already indicated; with hæmorrhages of importance it is almost, but not quite, an invariable symptom.

Delirium, which occurs in a limited number of cases in which hæmorrhage is a prominent lesion, is always, when present, a symptom of complicating superficial cerebral injury. Other less active mental disorders are also indicative of injury of a definite part and region of the cerebral substance.

Variations in size and reaction of one or both pupils are also common to all forms of intracranial injury. It was held by Hutchinson³ that a single dilated pupil indicated a hæmorrhage in the middle fossa of the cranial base of the same side. Reference to the cases cited in the comparative study of pial and epidural hæmorrhages show that it may be observed as well in hæmorrhages occurring in other localities, and further reference to cases of cerebral lesion will show that it occurs in them independently of any hæmorrhage at all. The contention that it is a pathognomonic sign is thus fully controverted. There is no reason to doubt that, like other pupillary disturbances, it is the result of cerebral contusion; but in what relation they stand to specific cerebral injuries is undetermined.

Temperature probably affords the most important indication of the nature of the essential lesion. Its relation to unconsciousness has been elsewhere formulated. In general it may be said that, succeeding the possible subnormal temperature of shock in any form of injury its degree of elevation will measure the amount of injury to cerebral tissue. A moderately elevated early temperature, which is nearly stationary, indicates a superficial hæmorrhage with no more than the usual complicating cerebral implication. If, however, with reaction, temperature rises in a marked degree, cerebral contusion is to be regarded as an essential, if not the paramount lesion, and, if progressive, it may be assumed that structural cerebral changes

are also progressive, while remissions and exacerbations, aside from septic complications, indicate fluctuations in the amount of the characteristic hyperæmia and œdema. At a later period elevation of temperature may have other interpretations.

The pulse is not characteristic with hæmorrhages, but with a large proportion of cases of cerebral lesion its frequency affords a sharp contrast to the elevation of temperature, and may be considered of diagnostic value. The respiration both in hæmorrhages and contusions is often normal, and when abnormal is rather more frequently quickened than retarded. While in superficial hæmorrhages, it is often full, slow, and stertorous, it is not so with sufficient frequency to establish a general rule. As a positive sign it has some significance; as a negative indication, it has none at all.

Focal symptoms may furnish the most conclusive indication, not only of the site, but of the nature of the intracranial lesion. The most frequent of these are various impairments of the intellectual faculties in cases of laceration of the left pre-frontal lobe. The fact that such disorders, aside from delirium, are connected with lesions of this origin alone has been adequately substantiated in the several publications of this writer at various times from 1894 to March of the present year. In one or two instances only, in which mental decadence had been manifested, there was found a large left frontal subarachnoid serous effusion without laceration; but even in these, as in all the others, there was sufficient evidence of contusion in hyperæmia and œdema if the case was recent, and of sclerosis if it was of longer standing.

Aphasia results from a cerebral lesion involving one or more of the speech centers situated in the third left frontal convolution and left temporal lobe. It has been asserted that it is also a result of compression of this region by a superficial hæmorrhage. The cases cited in support of this contention are not convincing, and are equally opposed to clinical and post-mortem observation, and to anatomical considerations.

Disorders of the muscular system occur in all forms of intracranial lesion, but not all of them with equal frequency

in each. Hemiplegia or hemiparesis, or paralysis affecting extremities of the opposite side, is not infrequent in cases of depressed fracture of the vertex, either from direct laceration of the motor area or from a superficial hæmorrhage; but with fracture of the cranial base, or with intracranial injury without fracture, it is probable that such a paralysis is the result of a hæmorrhage only, since cerebral laceration in this situation is unusual from contre-coup. Some degree of facial paralysis which is more frequently manifested than the other paralyses, and is sometimes due to injury to the facial nerve in its petrous position or to compression near its origin, is oftener a symptom of cerebral contusion, and perhaps explicable by gravitation of the serous fluid of an oedematous brain from above into the more dependent facial area. Paralyses of the ocular muscles are usually the result of lesions involving the corresponding cranial nerves at their origin. The same explanation is to be given of the paralysis occasionally observed of the pharyngeal muscles. General or local muscular twitching or rigidity are occasioned by the cortical irritation of hæmorrhages, or by direct superficial laceration. Convulsions on the contrary are not usual as a result of hæmorrhages, but indicate cerebral lesions of severity. Disorders of sensation are less frequent than paralyses, with which, if they occur, they are likely to coëxist.

The loss of rectal and vesical control, or of vesical control alone, which is the more frequent, is confined to cases of cerebral contusion of severity; and may be regarded as nearly pathognomonic. It occurs in a large proportion of both fatal and recovering cases of this character. It may be incontinence, but oftener the bowels move with some regularity; urine is discharged in considerable quantity and at more or less regular intervals. The sphincters are not paralyzed, and the lack of control is independent of the loss of consciousness, as it occurs equally when consciousness is retained. The explanation, therefore, must be sought in lesion of some specific centres of cerebral control as yet undetermined.

The occasional loss or impairment of one or more of the

special senses is due to mechanical injury of nerves in a line of fracture, to their compression by blood or other fluids in a basic fossa, or to lesions of a centre of control. Instances of the first are noted in deafness from implication of the auditory nerve in a fracture through the petrous portion of the temporal bone, and in blindness from implication of the optic nerve in a fracture through the optic foramen. Loss of the senses of taste and smell occurs and may be permanent in recovering cases, when, of course, the cause remains unknown. In some fatal cases with laceration of the frontal lobes the olfactory bulbs are found to be destroyed.

These varied symptoms of intracranial traumatism occur in manifold combinations according to the nature, severity, and complexity of lesions. When, as often happens, two or more lesions of nearly equal urgency or importance coëxist, with perhaps many symptoms in common and others ill-defined, or with a single one overshadowing all the rest, exact diagnosis may be impossible; but even then such knowledge of conditions present as may be attainable will ordinarily be sufficient to enable the surgeon to reach a reasonable conclusion as to the propriety of an operative interference.

In reaching such a conclusion several questions will demand consideration:

1. What may an operation be expected to accomplish?
2. Is it practicable?
3. Will it improve the patient's chances of recovery?

The answers to these several queries must be found in a fairly correct appreciation of the pathological conditions present. This will assume the recognition of the primary division of lesions into epidural and subdural as of essential importance.

The epidural lesion is easily accessible, and in suitable cases the operation for its relief involves a minimum danger and accomplishes a definite object. The subdural lesions on the contrary are in great part inaccessible, and the attempt to reach them by operative means is never without serious danger and always of doubtful expediency.

The operation for the removal of an epidural clot is in

itself practically, if not absolutely, without risk. The use of an anæsthetic is in a majority of cases uncalled for; sepsis and hæmostasis are within the control of the surgeon; and invasion of the cranial wall is unattended by serious shock. The object to be attained is simply the removal of pressure, and in the comparatively uncomplicated lesion and within the early period of time here contemplated, no irreparable nutritive changes will have occurred. The longer the cerebral compression is continued the stronger the probability that its effects, originally confined to hyperæmia and thromboses of the cerebral capillaries, will extend to, and fatally compromise the integrity of, the cellular elements. If it has been decided that a resort to operation is advisable, there should be no unnecessary delay after reaction has been established. If coma deepens, temperature declines, and the pulse grows weaker, there should be no waiting even for reaction, for hæmorrhage still continues, and there is no hope save in reaching and checking it at its source. In many cases of recognized or suspected epidural hæmorrhage, no question of operation will arise, as with reaction symptoms progressively improve till recovery is complete; and in many others death is too obviously imminent to admit the possibility of a successful issue. It is in the considerable remnant of cases in which symptoms of severity are stationary till reaction, and then with perhaps some hesitating improvement remain undecided for a time, that there may be legitimate doubt as to the propriety or to the time of interference. Even then the more positive the diagnosis of comparatively uncomplicated epidural hæmorrhage, the shorter the period of justifiable indecision. If with the exclusion of serious cerebral lesion symptoms indicate progressive hæmorrhage, the time for inaction has passed. No absolute rules of conduct can be formulated. The necessity of interference in each case, and the time, must be decided by the judgment and experience of the surgeon.

Conditions change when serious injuries affect the parts below the dura-mater. The question of operation then becomes more complicated, whether considered as an abstract proposition or in its relation to individual cases. It cannot be too

often repeated, that while a simple opening of the cranial cavity is devoid of danger, the invasion of the subdural space is never without it; in the one sepsis, always an appreciable possibility, is ordinarily remediable, and hæmorrhage controllable within the limit of safety; in the other, cerebritis with cerebral hernia is a frequent and often fatal complication, and the further loss of blood becomes a matter of perhaps the most serious moment. Shock is absent or trivial when the cranial wall alone is wounded, but is an essential element of danger when the cerebral substance is exposed and subjected to examination. Subdural operation in every case in which it fails of its purpose involves a danger of shock which greatly adds to the chances of a fatal issue of the original traumatism.

In a subdural operation for a meningeal lesion these dangers would be minimized; but as a pial hæmorrhage cannot be distinguished by its direct symptoms from one of epidural origin, nor a subarachnoid serous effusion be isolated from its associated cerebral œdema, they are both likely to fail as direct operative indications. A pial hæmorrhage may be suspected from a combination of the symptoms of hæmorrhage with those of a cerebral œdema, but is oftener unsuspected and disclosed only in the course of a search for the epidural lesion; and in a certain proportion of cases may then be adequately and safely relieved. The removal of a subarachnoid serous effusion is probably never the recognized object of operation, though it may be incidentally accomplished. If, however, either one of these conditions may be sufficiently disassociated from cerebral lesion of importance to permit independent consideration, there can be no question of the propriety of operation when indicated by the gravity of symptoms.

The object to be accomplished by operation in cases of epidural or pial hæmorrhage, or of subarachnoid serous effusion, the relief of pressure, is definite and technically practicable.

It is in the class of intracranial injuries which exclusively or largely involves the brain substance that the greatest uncertainty has been felt as to the advisability of operation. It has been due in part to a failure to discriminate between the visceral

lesion and an epidural or pial hæmorrhage, though a contusion of the brain of such severity as to suggest operation should hardly fail of recognition if ordinary care were used in the examination of the case. If the rise in temperature is not in itself deemed pathognomonic, the loss of rectal or vesical control, or some focal symptom, which is characteristic, ought to afford sufficient confirmation. Even in the presence of a hæmorrhage, some one or more of these indications should be in evidence.

Another cause of uncertainty as to the advisability of operation has been a failure to consider what it might reasonably be expected to accomplish. The essential brain lesions of traumatic origin, as already noted, are laceration and limited or diffuse hyperæmia and œdema. Laceration of the motor area may be recognizable either as an essential or as an incidental lesion, and as such is accessible in operation; but in general lacerations are not distinguishable from the general contusion of which they are part, and in the vast majority of cases are situated at the base or in other inaccessible regions of the brain. Persistent paralyses of the extremities from laceration of the motor area may afford legitimate reason for operation, but it is questionable if the result will often justify expectation. The objects to be obtained are primarily the relief of pressure from attendant hæmorrhage, and, secondarily, the exposure of the cerebral wound for aseptic treatment. The occasional instances in which this method of treatment has been adopted have not demonstrated that it adds to the patient's chance of recovery. Limited contusion, possibly indicated by some focal symptom, can never suggest operation, as it is in itself void of danger.

The one cerebral lesion remaining, which probably exists in all intracranial traumatisms, and is the direct cause of death in a large proportion of fatal cases, is a general hyperæmia and œdema, which primarily exerts an intracerebral pressure, coincidentally or secondarily deranges cellular nutrition, and ultimately tends to destroy vital functions.

If any good can come from trephining in such cases it

must be by relieving intracerebral pressure, and thus permitting the reëstablishment of a normal capillary circulation and the restoration of normal nutritive processes. It is obvious that as with epidural hæmorrhages there are many cases which end in spontaneous recovery as there are many others which equally proceed to an inevitable result. In an intermediate class, in which operative interference might be of possible service, there is an indefinite time beyond which circulatory derangements will have already extended to the vital area, or cellular degeneration will have extended to a point beyond repair. It becomes a question, therefore, not only of what possibility of relief there may be in an operative procedure, but in what cases and within what limit of time it may be effective.

The importance of œdema as a definite and often fatal lesion was long unappreciated; and even yet, in the absence of gross hæmorrhages or lacerations, brains on post-mortem inspection are not infrequently pronounced normal when the œdematous condition is most strongly marked. Not longer ago than 1860, Prescott Hewitt,⁴ while he more clearly than his predecessors recognized the fact that so-called concussion was really a structural brain injury, and noted the punctate hæmorrhages and extravasations, made no mention of the serous exudation. In later years, when an intracerebral pressure became more generally accepted as a factor in the genesis of symptoms, there was a disposition to regard hyperæmia of the cerebral vessels and subarachnoid serous effusion as the sole causative agents, even while the existence of cerebral œdema was recognized, and writers had formed various theories as to the manner of its production. The neglect of a study of temperature as an essential element in the diagnosis of intracranial lesions may account for the failure to recognize the importance of œdema in the progression of cerebral symptoms.

The limitations of operative treatment in cases of cerebral hyperæmia and œdema are readily deducible from a consideration of the nature of the changes which occur. Simple circula-

tory derangements are capable of spontaneous readjustment; the cerebral vasomotor centres may recover from the primary shock to which they have been subjected, capillary thromboses and extravasations and incidental serous transudation may be reabsorbed, and initial nutritive changes may be checked. The forces of nature may be aided in their progress to recovery by such remedies as will diminish arterial tension, if it exist and equalize the general circulation; but it is not easy to understand how the action of these natural forces can be facilitated by trephining the cranial wall, since the swelling of the viscus from mere dilatation of the vessels is insufficient to seriously compromise the cranial capacity.

Furthermore, the nutritive derangements are not due solely to mechanical cause. The œdema, which follows primary hyperæmia, and is found post-mortem in some degree in all cases, "is mainly the result of an active process in the tissues themselves."⁵ It was regarded as a simple serous transudation due to capillary obstruction until experimental researches were made by Cannon,⁵ which seem to have demonstrated that it is the result of "internal nutritive changes" "leading to increased osmotic pressure with passage of water into the tissues," "in which processes blood pressure is not a necessary factor." In either case, whether in the order of events the œdema is the result of an active or of a passive process, whether it is the cause or the sequence, cellular nutrition is progressively impaired and function correspondingly inhibited or destroyed.⁶

It follows that with the lapse of time a new condition is to be met in considering the question of operative treatment. In the beginning, the readjustment of the cerebral circulation may be practicable by the removal of external compression, as is often accomplished in the case of epidural hæmorrhages. It would also be theoretically practicable in the case of cerebral contusions up to the time when structural changes progress beyond the reparable stage, provided intracerebral pressure were the sole cause of the cellular degeneration.

There is, however, reason to believe that it is not the vas-

omotor centres alone which suffer from the primary shock of injury, but that nutritive changes may depend upon a similar impression made upon the nerve cells in general, and thus have an independent origin apart from the circulatory disturbance. It is often noted in post-mortem cases in which epidural hæmorrhage has been large, that there is no indication of any considerable vascular change. The brain is neither markedly hyperæmic, anæmic, or œdematous. Death has not been so sudden as to justify a supposition that there has been paralysis of the respiratory centre, nor are the appearances presented such as to suggest a fatal bulbar anæmia gradually induced by the superincumbent pressure. Again, in cases of uncomplicated contusion, as previously stated, vascular change and œdema are often disproportionate to each other, and often disproportionate to the severity of antecedent symptoms. In some instances the vessels are not greatly dilated, and the œdema is in only moderate degree when so-called pressure symptoms have been severe; in others, œdema is excessive when the blood in cerebral circulation has apparently been neither diminished in amount nor impeded in its course. In all these cases pressure alone, whether extracerebral or intracerebral, is inadequate to explain wholly the progress of symptoms to a fatal termination. That supradural or subdural compression may be a contributing or even the efficient agent in the production of symptoms is evident in many instances from the result of elevation of bone or removal of clot. That intracerebral pressure may be a contributing agent in the progress of the nutritive disorders incident to cerebral contusion may be properly assumed, but its pathological improbability as the essential cause is not diminished by the results of trephining in such cases. The writer, therefore, has been led to modify the view previously expressed,⁷ that primary shock affects only the cerebral centres of vascular control, and that its ultimate effect depends solely upon anæmia from pressure. He is now more inclined to believe that the primary impression extends to the nerve cells in general, and that, in the severer cases especially, the fatal nutritive changes result in greater part from the general cellu-

lar implication in shock, and not indirectly through the vascular derangement. If this be true, operative procedure even at an early period is still more likely to be ineffective than if pressure alone, which might in some degree be relieved by the opening of the cranium, were the essential pathological condition.

The cases in which primary shock may be supposed to be essentially limited to the vasomotor centres include all those which speedily recover after the transient unconsciousness with slight disturbances of pulse and temperature. Other cases with similarly restricted lesion, in which unconsciousness and elevation of temperature are somewhat more prolonged, will recover with or without surgical methods short of operation; while those in which from the very first, profound vascular disturbance and rapidly progressive anæmia are indicated, can hardly be benefited by so simple a procedure as the removal of an osseous fragment.

In the larger group of cases in which operation may be proposed, and in which the primary shock has been extended to the general mass of cerebral cells, the relief of pressure by opening the cranium becomes, in the light of Cannon's investigations, and of post-mortem observations previously cited, illogical and ineffective. If the origin of the fatally progressive destruction of cells resides in greater part in an inherent defect of nutrition which is the cause and not the result of œdema, no remedy can avail which ignores this pathological fact. As a pressure from cerebral hyperæmia and a resultant œdema is not the essential cause of the cellular disintegration, which is the real source of danger in the class of cases in which operation is oftenest held to be in question, trephining which can only relieve pressure must be useless and worse than useless, because it makes possible new elements of danger.

If it were conceded that the nature of the lesion were such that at some certain time when natural forces had proved to be ineffectual to stay destructive processes, but when they might be still amenable to control by operative relief of intracerebral pressure, it would even then be impossible to fix that time.

There is no positive progression of symptoms by which the order of pathic changes can be estimated. The gravest symptoms—prolonged unconsciousness, high temperatures, and loss of both rectal and vesical control—may precede more or less sudden change for the better and ultimate complete recovery; or a continued moderate elevation of temperature with no urgent symptoms may be followed by complete loss of consciousness, a high range of temperature, and a speedy fatal termination. Prognosis in cases of moderate severity is little more than guess-work. Temperature is the only indication of value, and this, however positive as a diagnostic sign, or reliable in its exacerbations and recessions as a measure of conditions at the moment, cannot be trusted as pointing to the ultimate result until it has passed the dead line of 105° . In the observation of more than one thousand cases of intracranial injury there was no instance of recovery when that degree of temperature was exceeded by even the smallest fraction.

It may be said that practically all cases of cerebral concussion fall into two classes:

1. Those in which symptoms are not urgent, a large majority of which, as experience teaches, recover by the use of ordinary measures of treatment.
2. Those in which symptoms are of alarming severity, a large majority of which, as experience also teaches, are destined to end in death whatever method of treatment may be adopted.

In neither case are exploratory operations justifiable; in neither one will operation be simply nugatory; it will do harm if it does not do good.

An operation for the purpose of establishing diagnosis is, moreover, unnecessary. Careful analysis and study of symptoms will sufficiently determine the nature of intracranial conditions present to enable the surgeon to exercise his judgment in deciding upon the better course of treatment to pursue. The exact extent and location of lesions may be so far indeterminate as to render the result of an operation uncertain, and in

this sense experimental; but this is not to be confounded with exploration.

It is probable that those surgeons who operate early and often will save many cases which would otherwise have sooner recovered, and that those who operate later in cases which have assumed a graver character will lose some which might have recovered if the cranium had been left intact. It has been the hope of surgeons who have been in the way of seeing many cases of intracranial injury that operation might be extended with advantage to these cases of cerebral traumatism, but the present state of our knowledge of the pathic conditions which obtain affords no reason for believing that this hope will be realized.

SUMMARY.

1. Epidural hæmorrhage demands operation in such cases as do not obviously tend to spontaneous recovery, or in which a fatal issue is so imminent as to permit no question.

2. Meningeal contusion, when productive of symptoms, either cannot be diagnosticated from an epidural hæmorrhage, or is indistinguishable from the diffuse cerebral œdema with which it is always associated. A recognized intracranial hæmorrhage may be expected to be of pial origin when associated with cerebral lesions, and will indicate operation when the cerebral lesion is regarded as of minor importance.

3. Cerebral contusion. (a) Limited—no tendency to a fatal termination, and never suggests operation. (b) Diffuse—two classes of cases; in one, a vascular disturbance incapable of self-limitation, not markedly involving the integrity of the cerebral cells, but tending to mechanically destroy their function; in the other, a progressive disintegration of cellular structure, an active process due to chemical changes, which natural forces prove insufficient to restrain. In the first, operation is theoretically indicated; in the second, in view of the origin and nature of the pathic changes, there is no reason to suppose a simple relief of pressure will stay their progress. In neither is it possible to fix the time when operation may so

supplement natural forces and simpler remedial measures as to increase the patient's chances of recovery.

4. Mixed cases—cerebral contusion complicated with pial or epidural hæmorrhage. Operation should depend upon the estimated relative importance of the lesions; and the correctness of this estimate must depend upon the acumen and experience of the surgeon.

NOTE.—Since this paper was written an article has been published by Murray⁸ upon the operative treatment of intracranial hæmorrhages. I quite agree with this writer that the "important point for the surgeon is to recognize the presence of intracranial hæmorrhage, and if the symptoms of compression are severe, to immediately relieve the compression, no matter what may be its source"—if practicable. I am also in accord with him in the belief that "the skull should not be opened in every doubtful case." Some of his statistical and other conclusions, however, are not in consonance with my own observations and experience. Those observers who are quoted as stating that over 90 per cent. die under "expectant treatment," have been singularly unfortunate, if by expectant treatment is meant treatment without operation. I find from the record of my own cases of intracranial injury that of 100 cases of most recent occurrence 30 were fatal. In 16 cases resort was had to operation, with 5 deaths. The 25 fatalities in the 84 non-operative cases represent a fraction less than 30 per cent., practically the same percentage as that noted for the whole series. These were all cases of importance taken in chronological order without selection. The operative cases were: Eleven of depressed fracture of the vertex, 1 of pistol shot wound, 3 of hæmorrhage into the basal fossal with cerebral contusion, and 1 in which operation seems to have been done without adequate reason. Seventeen necropsies were made in the cases where death occurred without operation; and an analysis of post-mortem findings in these shows no one in which operation, if practicable, might be supposed to have been of service. These necropsies, therefore, do not, as expressed

by Dr. Murray, "reveal the fact that early resort to trephining would have been followed by success"; nor does it seem from the history of these cases that, "as regards more frequent exploratory operations it would seem that it is clearly indicated."

Again, the record of 300 or more necropsies which have been made in my own cases do not sustain the allegation that "contusion of the brain is not so frequent an accompaniment of subdural hæmorrhage as was formerly supposed." On the contrary it has been almost uniformly present even when the subdural hæmorrhage has been wholly pial. As previously noted, punctate extravasations and even excessive hyperæmia and œdema are frequently overlooked in post-mortem inspections, and the brain pronounced normal in the absence of laceration.

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FRACTURE OF BASE OF SKULL.

ANALYSIS OF 530 CASES, WITH PARTICULAR REFERENCE TO TREATMENT AND PROGNOSIS.

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FROM June 1, 1864, to September 1, 1906, the surgical records of the Boston City Hospital show 530 cases of fracture of the base of the skull. The total fractures of all kinds treated, both in the hospital and as ambulatory cases in the out-patient department, is 35,816. Fracture of the base of the skull stands ninth in frequency; this number, of course, represents only those which came to the hospital alive. Many of these cases never come under treatment, because the other injuries to the brain suffered at the same time cause immediate death.

By the courtesy of the staff of the hospital we have been able to analyze these cases. After finishing this study we are convinced that it has been worth the time, because (1) we found that the records of these particular cases are well kept in detail; (2) the number of cases is large enough to give a fair idea of the frequency of symptoms; (3) certain conclusions as to treatment and prognosis seem to be warrantable.

SUMMARY:—FRACTURED BASE OF SKULL; BOSTON CITY HOSPITAL.

May 24, 1864, to September 1, 1906.

Total number of fractures.....	35,816
Total number of fractured skulls.....	1,436
Total number of fractured base of skull.....	530
Number of fractured bases which recovered.....	299
Number of fractured bases which died.....	231
	823

<i>Hæmorrhage.</i>	<i>Lived.</i>	<i>Died.</i>	<i>Total.</i>
Number of cases having hæmorrhage.	214	181	395
One ear	170	111	281
Two ears	16	31	47
Mouth	17	27	44
Nose	73	95	168
Subconjunctival	32	21	53
<i>Pupils.</i>			
Equal	212	69	281
Unequal	65	90	155
Dilated	17	57	74
Contracted	5	15	20
Reaction normal	272	70	342
Reaction slow	16	30	46
Reaction absent	11	131	142
<i>Knee-jerks.</i>			
Normal	204	17	221
Absent	15	24	39
Unequal	10	1	11
Increased	8	21	29
Diminished	8	22	30
<i>Paralysis.</i>			
Face	31	15	46
One limb	3	10	13
One side	5	36	41
General spastic	1	13	14
Ptosis without facial paralysis.....	5	0	5
Nystagmus	7	6	13
Strabismus	12	13	25
<i>Exophthalmos</i>	6	8	14
<i>Alcohol</i>	106	64	170
<i>Respiration stertorous</i>	11	106	117
<i>Operation</i>	28	31	59
<i>Conscious</i>	201	97	298
<i>Unconscious</i>	98	134	232
<i>Vomiting</i>	36	42	78
Average stay in hospital, died.....	2½	days	
Average stay in hospital, lived.....	16	days	
Average stay in bed of living.....	10	days	

Causes.—Of the 530 cases here summarized, 231 or 44 per cent. died. Eighty per cent. of the cases received the injury

by falling, at least half of them only in falling backwards from a standing posture; the remaining 20 per cent. were injured by assault or some other form of external violence.

Alcohol, to an intoxicating degree, was found present in 170 cases, or 32 per cent.; this must be noted as amongst the contributory causes. Of this number 64 cases or 38 per cent. died. Of the alcoholic, many died with delirium tremens, which could not be wholly differentiated from symptoms of laceration or meningitis.

Consciousness.—Two hundred and thirty-two cases or 44 per cent. were noted as unconscious at first examination. Of the conscious ones, fully half, or three-quarters of the whole number of cases, were dazed or stupid, or could be roused only with considerable effort; 58 per cent. of the unconscious died, while 33 per cent. of the conscious died. We are warranted to conclude, therefore, that loss of consciousness, in itself, has little bearing on the matter of prognosis.

Neither depth nor prolongation of primary unconsciousness is in itself a measure of danger. Phelps observes that it is not unusual for complete loss of consciousness to continue for some days without concomitant or subsequent symptoms of special severity. The loss of consciousness which occurs at a later stage is of serious significance, showing increase of cerebral œdema, continuous hæmorrhage, or meningeal inflammation.

When delirium appeared early, in most cases, it was due to the effects of acute or chronic alcoholism. It always signifies circulatory disturbance, but when it appears late this disturbance is produced by infection.

To the remote effects on mentality we shall refer later.

Deformity.—Absolute change in contour of the skull was practically never seen, unless the fracture also involved the vault.

Scalp Wounds.—Scalp wounds were present, of course, in a large number of cases, and served in a measure to guide one to the site of the primary blow. Scalp wounds whether connected with the basal fracture or not should be thoroughly

cleaned and closed. If pus develops in the ear, or if the patient lives to develop basilar purulent meningitis, radical operation, for the purpose of drainage, should be attempted.

Ecchymosis.—Ecchymosis directly after the injury may, of course, appear at the site of contusion and have no relation to the basal fracture.

Ecchymosis appearing two to ten days later is most commonly observed behind the ear, particularly behind the ear which had shown bleeding; another common site of ecchymosis was the upper eyelid.

Hæmorrhage.—In our total of 530 cases, 395 or 74 per cent. had hæmorrhage from at least one orifice.

Bleeding from one cranial orifice is the commonest symptom of fractured base; bleeding from one orifice is the usual condition; bleeding from two, much less frequent. The order of frequency is: One ear, 281; nose, 168; sub-conjunctival, 53; two ears, 47; mouth, 44.

Ears.—Bleeding from at least one ear is the pathognomonic sign of fractured base in common practice. Walton¹ in his 50 cases found that "bleeding from one or both ears was noted in 21 cases. In three cases it was described as profuse, and in one case as persistent. In none of these four cases was middle meningeal hæmorrhage found on autopsy; nor, indeed, evidence of rupture of any of the large vessels, either arterial or venous; conversely, middle meningeal hæmorrhage was found in nine cases, in eight without bleeding from the ear, in one with slight bleeding." Hæmorrhage from the ear does not, of course, necessarily imply the existence of a basal fracture, but practically if the hæmorrhage is severe it must come from the mucosa of the drum, or the middle ear, and hence must mean bony injury.

As a matter of fact, in practically all cases in our records where careful aural examination has been made with the head mirror, rupture of the drum has been found. Rawling² has observed that bleeding from both ears is a much more serious sign than from one, though this difference seems to be less true in children.

It was formerly advised to irrigate the auditory canal in cases with bleeding from the ears. This is no longer to be recommended, for the same reason that irrigation is no longer used in many surgical procedures, namely, that by it septic outside matter may be washed into deeper recesses. The external ear and canal should be thoroughly cleaned by wet wiping, and the external orifice closed by a bit of sterile or corrosive cotton, but the ear should not be tamponed.

Nose.—In 126 cases where bleeding from the nose was noted probably a great proportion were suffering from injury to the nose itself, not basal fracture connecting with the nasal cavity.

This symptom is of little value in diagnosis or prognosis unless the persistency is notable.

Mouth.—Bleeding from the mouth must be investigated with great care in each case, to rule out its origin from wounds of the tongue or lips.

Pharyngeal hæmorrhage has been observed by us in 44 cases, of which 27 cases or 61 per cent. died. Fracture of the base which extends in such manner as to tear the mucosa of the pharynx must approximate the median line. It implies great force to cause it, and the mortality is very high. Autopsy in these cases shows that the fissure has passed through the pituitary fossa and that the mucoperiosteum of the under surface of the body of the sphenoid is torn. Von Bergman had one case where so much blood entered the air passages from the fracture opening into the nasopharynx, that tracheotomy was done and saved the patient's life.

Sub-Conjunctival.—Blood under the conjunctiva, when due to basal fracture and not to direct injury to the eye, implies fracture to the roof or outer wall of the orbit, but is not pathognomonic. On this point Walton³ remarks: "Sub-conjunctival hæmorrhage led in one case to the diagnosis of basal fracture, not confirmed by autopsy. This will serve to remind us that sub-conjunctival hæmorrhage is no infallible sign of fracture other than fracture of the outer wall of the orbit."

Pulse.—The rapidity of the pulse in our cases seems to be of little importance apart from general surgical principles. The quality is of greater value, serving as an indicator of the general condition and successive observations showing the effect of hæmorrhage or other changes in condition. Phelps⁴ observes that in general, the normal or full pulse is equally characteristic in fatal and recovering cases. The failure of cardiac force is neither more nor less threatening in this than in other forms of injury.

Respiration.—Respiration seems to have little significance, unless it be in the primary shock or toward the fatal termination. It was noted as being stertorous in 117 cases, of which 106 died. Phelps⁵ concludes that the irregular respiratory rhythm indicates a dangerous intracranial pressure, and an extremely infrequent respiratory act means probably a fatal injury to the medulla.

Temperature.—A sub-normal temperature seemed to indicate great shock, or alcoholism; most of the cases had normal temperature, and a few on entrance had elevated temperature. Of those that had high initial temperature nearly all died.

Phelps⁶ states that in uncomplicated hæmorrhage the temperature ranges from normal to 100°, but if cerebral concussion is well pronounced 101° may be reached. Cerebral laceration is characterized by higher initial temperature, and, when severe, by an early and rapid progressive increase. Our cases confirm his observation, that persistent depression of the temperature measures the danger from primary shock, unless due to alcohol, and that its rapid rise later gauges the severity of meningeal or cerebral lesion.

Proptosis Oculi.—Exophthalmos, due to blood in the orbit, is mentioned by Rawling as a rare complication. It has been observed by us several times in the most serious cases, but very rarely in cases that got well. As a rule, it has been accompanied by chemosis.

The Escape of Cerebro-Spinal Fluid.—The escape of serous fluid from ear or nose was not noted in more than 27

cases, though other writers speak on the subject to great length as if it were common.

Flow of cerebral fluid from the ear means fracture in the middle fossa, laceration of the petrous portion and its dura, into the sub-arachnoid space. It may rarely mean the posterior fossa, but fracture here, to allow fluid to escape, must tear the facial nerve and the tubular prolongation of the arachnoid round it. Hence flow from the ear without facial paralysis means fracture of the middle fossa.

Elaborate chemical tests have been devised to recognize cerebrospinal fluid, but these are complicated and unnecessary. This fluid may be diagnosticated, as Rawling⁷ puts it, if it begins to come from the ear within twenty-four hours, is practically colorless and continues some days. Tympanic excretion is cloudy, small in amount, and usually appears not until at least twenty-four hours after the injury. Rawling quotes Sir William Savory's case where this cerebro-spinal fluid poured for a month; and another from Sir William McCormack where three pints were collected in five hours. This flow from the nose is very rare, though it is said to come from the Eustachian tube when fracture enters the ear without rupture of the tympanum.

Pupils.—By referring to the table above it may be seen that statistics on the relation between pupils and basal fractures can be made to lend themselves to every and all theories. In short, pupillary condition is only a general aid in diagnosis or prognosis. Thus, in 142 cases without reaction, 131 died; this probably is the most striking result of the study of pupils. Nichols⁸ similarly reported that in 54 cases of head injury, with non-reacting pupils, 47 died, and that in 24 cases diagnosticated as basal fractures all were fatal.

In 46 cases described in our records as "reaction slow," 30 died. On the other hand, in 155 cases where the pupils were unequal in size only 90 died, but where both were dilated or contracted, in a total of 94 cases, 72 died. If any conclusions then are warrantable they are that loss of mobility of the pupils

is far more grave than mere inequality, such as may result from temporary irritation.

On this question Walton⁹ concludes, "Doubtless various factors play a part in producing the altered pupils in this lesion, but if disorder of any simple mechanism is to be credited with the production of the Hutchinson pupil or other pupillary changes noted, the only lesion worthy of this place is disturbance, irritative or paralytic, of the intracranial fibres of the ciliospinal tract. This tract after leaving the cervical sympathetic passes into the base with the carotid plexus, thence forward by the ophthalmic division of the fifth and its nasal branch, having first passed over the Gasserian ganglion. The fact is established that irritation of this tract causes dilation, and its destruction, contraction of the pupil. This tract is peculiarly susceptible to injury at the apex of the petrous bone."

Paralysis.—Contrary to the impression to be obtained from many writers, we have found paralysis of the cranial nerves relatively uncommon, and our knowledge on the subject is largely obtained from Rawling's Hunterian Lecture.¹⁰

PARALYSIS OF CRANIAL NERVES.

1. *Olfactory Nerve.*—This nerve is involved in fractures of the orbital plate, but immediate loss of smell due to injury to the nerve is difficult to determine, because in such a case the nose is blocked with blood at first. It is fair to say that loss of smell at first is fairly common, but permanent anosmia is very rare.

2. *Optic Nerve.*—Immediate loss of sight from fracture of the base, in cases which are able to tell of it, is a very rare occurrence, because most fractures near the optic foramina tend to pass either between them or external to them through the sphenoidal fissures.

3. *Motor Oculi Nerve* may be injured in the orbit, or be pressed upon by blood, and the prognosis depends on which occurs.

4. *Pathetic Nerve.*—The pathetic nerve is practically never involved alone.

5. *Trifacial Nerve: Ophthalmic Division*.—Pressure of hæmorrhage may cause complete loss of function of one or more branches. Thus complete anæsthesia of both cornea and conjunctiva, with subsequent ulceration, has been observed. The maxillary divisions of the fifth nerve are rarely involved, though the Gasserian ganglion has been injured in fracture.

6. *Abducens*.—Injury to this nerve is not due to blood but to actual injury, the injury occurring where the nerve runs along beside the sella turcica.

7. *Facial Nerve*.—The facial nerve is more commonly involved than any other, because of its passage through the petrous portion. Kohler found 22 cases out of 48; Battle found 15 in 168; Bidwell found 15 in 106 cases; Rawling found 24 in 60 cases; and we find 46 in 530 cases. In our 46 cases it was present in only two or three cases at the time of entrance, but generally came on from three to six days after the injury. The paralysis seemed to be of short duration; most of the cases having recovered, or almost so, at the time of their discharge from the hospital.

8. *Auditory Nerve*.—Facial paralysis is practically always complicated by involvement of the eighth or auditory nerve. Injuries to these nerves Rawling divides into two groups: (1) Early and partial paralysis of the facial nerve accompanied by a variable degree of deafness; (2) early and complete paralysis of the facial nerve accompanied by complete deafness.

Undoubtedly, many cases of slight facial paralysis, clearing up later, are unobserved in these cases, because of the predominant importance of other symptoms. In most cases the facial affection is due to pressure from blood-clot; this is absorbed, and recovery is complete. Deafness frequently recovers unless the ossicles are severely damaged, or in the second class of cases when the whole inner auditory apparatus is shattered by fracture.

9, 10, 11 and 12. *Vagus Nerve*.—Rawling refers to four cases where sudden dyspnœa or other symptoms have occurred when subsequent examinations have showed injury to the

vagus nerve as it passed through the jugular foramen. Injuries to the hypoglossal nerve have not been recorded.

Skeletal Paralysis.—Paralysis of one limb, one side, or general spastic paralysis, has been occasionally noted in our records. Such paralysees usually mean complicated cerebral injury, and practically all of them die.

Paralysis of Bladder and Rectum.—These paralysees in basal fractures have little value in diagnosis or prognosis. In injury to the cord the bladder fills up almost indefinitely, but in cerebral injury, after a certain moderate stage of distention, the bladder will empty itself. Retention in both bladder and rectum, though it sometimes occurs in hæmorrhage, is not indicative of the nature of the lesion, but is merely a result of the unconscious state however produced.

Loss of fecal and urinary control of cerebral origin, persistent after the return of consciousness, means laceration regardless of the region of the brain involved.

Reflexes.—Nothing apparently of value is shown by our records of condition of the reflexes on these cases. Thus, in 221 cases where they were normal, 17 died; in 39 cases noted as without reflexes, 24 died. The signs of Kernig and of Babinski have not been noted over a sufficient number of years to be of value in our records. In general, increased or diminished knee-jerks, other things being equal, have a bad significance. Walton¹¹ says: "The reflexes (excepting the cremaster) may be wanting immediately after cerebral trauma, only to become extremely active within a few hours. Whatever lesson is to be drawn from the reflexes in these cases, it should not be regarded as specially diagnostic of basal fracture, but as resulting from violent jarring of the intracranial contents, accompanied perhaps by local bruising and by hæmorrhage, either limited or extensive."

Vomiting.—Because of the frequent presence of alcohol, in these cases, the significance of vomiting is almost nothing. It may signify only general cerebral contusion, or actual injury to the floor of the fourth ventricle. In 57 cases, 25, or 44 per cent., died.

Operative Treatment.—Out of the 530 cases of fractured base, 59 were operated; of these 31, or 53 per cent., died. In studying over these operative cases there seems to have been two reasons for operative intervention: definite signs of hæmorrhage, and a belief that hæmorrhage might be present.

In few of these cases there was found a rupture of the middle meningeal artery, with more or less blood-clot and compression of the brain substance. In the remainder nothing relievable was found on opening the skull.

The question arises as to what class of cases demands operative intervention.

It seems to us that only those cases should be trephined in which hæmorrhage seems to be the most important part of the clinical picture and the history of the case or the course of it under good observation has been one showing continuous and progressive intracranial compression.

The patient with non-reacting pupils even if they are unequal, the patient unconscious with stertorous respiration, nearly always is bleeding from the anterior cerebral artery or some similar vessel deep in the brain substance, blood welling up from the dura, impossible to stop.

Operating on these hopeless cases brings only discredit to surgery, unless the friends of the patient clearly understand the small chance of relief following operation and, so understanding, request it.

Immediate Prognosis.—Death occurring within a very short time results directly, in full 50 per cent. of these cases, from laceration of the brain and attendant hæmorrhage. The liability of laceration along the base is particularly great, on account of the many irregularities of the basal surface. Walton¹² states: "In studying these records one finding impressed itself upon me which, so far as I am aware, has not been sufficiently noted, viz., the frequent disintegration of the under-surface of the frontal lobes posteriorly, and the under-surface of the temporal-sphenoidal lobes anteriorly, that is, the region of the fissure of Sylvius. This can only be due, it seems to me, to

impact of these regions against the lesser wing of the sphenoid, which fits into the fissure of Sylvius to separate these lobes."

Patients with fractured base are in the most critical time during the first forty-eight hours.

The matter of immediate prognosis is most ably summarized by Phelps¹³ thus: "The probability of the existence of particular lesions, based on their known frequency and the estimation of their relative danger, will have a certain prognostic value. The uncertainty which attends the issue of traumatism is great, not only at the beginning, but at a later period when recovery is apparently assured. The immediate danger is to be measured by the profundity of shock, the depression of temperature and the involvement of the pulse, and in some instances by the visible injury: but reaction is still possible under conditions which seem to be hopeless. The question of prognosis, which more seriously involves the judgment of the surgeon, arises with the passing of the initiatory stage."

Although, as has been noted, prolonged primary unconsciousness may mean nothing, if, during it, the pulse, temperature or other symptoms do not improve, or become more unfavorable, the unconsciousness may be considered very serious.

The matter of prognosis from day to day is not one that can be expressed at any stage with exactness, but is one that must depend upon the surgical sense and experience. Phelps¹⁴ closes the discussion of the subject thus: "There is no class of injuries in which the issues are at all times so uncertain and so surprising. The cases which in their early days present the mildest symptoms and seem most destined to unobstructed recovery, may at some later period assume a threatening and alarming character and perhaps prove fatal in the end; as others in which the combination of symptoms long justifies the gravest apprehension, may eventually terminate not only with preservation of life, but with perfect restoration of long-disordered or suspended function." There are evident lesions so extensive or symptoms so clearly desperate, that a fatal end is unquestionable; but no condition can be so favorable as to assure recovery.

The prognosis must be in general not only guarded, but subject to revision from day to day, until all direct symptoms have disappeared, and temperature has been for a length of time practically normal.

Remote Prognosis and After-Effects.—The lesions of the subjective centers in the frontal lobes are frequently indicated in recovering cases by the existence of motor sensory aphasia. Delusion, loss of memory, defective judgment, and mental decadence indicate, in most cases, laceration. This has been demonstrated by conjoined clinico-pathological observation to involve the left frontal lobe.

One of the remote after-effects of fractured base, and indeed even of cerebral contusion, seems to have been little noted in the literature. We refer to the changes in character and disposition. It is not possible from the nature of this kind of change to be able to reach definite statistics or details concerning it: in a large number of cases partly because the patient and his closest friends are tempted to cover it, and partly because those who are not his friends might exaggerate it. There seems, however, to be but little doubt in a number of cases where we have been able to meet the patient, or talk at length with his friends in a perfectly sympathetic way, with the idea of getting at the whole truth, without asking leading questions, that such changes may take place in any injury of this type.

A considerable amount of our work has been directed to investigate the remote after-effects and final results in these injuries. Where personal interviews were not possible we have endeavored by correspondence to learn the present condition, and these are types of the replies:

"I received your postal card in regard to my injury of April 12, 1900. Would say my memory has been very poor since the accident; I have had to give up work more or less."

"In replying for Mr. T. J. S., it should be stated that he has complained to me on all occasions that he is troubled much with headache and with his eyes, and that his chief troubles at present are dizziness, which he says is very persistent, and deafness, which is very marked. It seems to

me personally that he is growing worse in this connection, for he complains very much of a buzzing noise in his left ear, which he says annoys him almost constantly.

"He does not use alcoholic drinks to any extent. Bright sunlight affects his eyes while driving; he has always been a coachman and is still engaged in that business, but does not work without considerable difficulty and embarrassment.

"He says it was about nine weeks after he left the hospital before he went to work, and then he began by degrees.

"He is not troubled with paralysis, fainting spells, or fits."

"My husband received a postal from you, asking him to let you know about his health since he was in the hospital with a fractured head.

"He has not been well since, and he could not go away for five months after coming out of the hospital, and he can't stand working so long as he did before he was sick. For two months there was a running out of his right ear, and he is deaf now in that ear, and the sight of his right eye is 'most gone.

"When he drinks I can see a great difference in him; he gets 'most crazy; also when he is sober I get afraid of him, the way he swears and loses his temper for just no cause. He has had fits four times."

An attempt was made to find the most accessible 200 of our 530 cases, but the population from which a municipal hospital draws, and the kind of people that most commonly receive this injury change residence so often, that of this great number only 38 cases could be found. Their replies to specific questions are collected in the following table:

	<i>Yes.</i>	<i>No.</i>
Headache	13	25
Eye troubles	17	21
Dizziness	15	23
Deafness	16	22
Paralysis	1	37
Fainting spells	4	34
Fits	2	36
Loss of memory	4	34
Troubled by sunlight	13	25
More easily crazed by alcohol	6	32
Worked since injury	15	23
Same work since injury	21	17

Eight have not yet worked since injury. Eight and one-half weeks from the time of injury was the average period

before going to work, varying between one week and two years.

Inability to work as hard as formerly seemed to be the chief cause of complaint; the patients becoming easily tired and not able to fix their minds on their work as they had been previous to the accident. Seventeen of these cases complained of poor eyesight where previous to the accident their eyesight had been perfectly good. None of them were people who used their eyes to any extent in their work, as they were all laboring men. Fifteen complained of dizzy spells from which they had not suffered previous to the accident, and many of these complained of the effects of bright light which often brought on these dizzy spells. Deafness was also often complained of, sixteen cases being more or less deaf in one ear—the ear in which the hæmorrhage came at the time of the accident. Alcoholic drinks did not seem to have any more effect than previously; only six stating that it did. Wives of the patients, however, state that their husbands are much more irritable and vicious when under the influence of liquor, than they were previous to the accident. Twenty-one are doing the same work in which they were engaged before the accident; seventeen are pursuing a different occupation of a lower grade than before, or no work at all, of which latter there were eight. These patients state that they are not able to stick to their work “on account of their head.”

Time in Bed.—The average stay in bed for those who lived was ten days; in the hospital sixteen days. This we believe to be quite insufficient.

As examples of injuries in the course of which too early freedom from restraint was allowed, the following are quoted:

CASE I.—J. S., thirty-two, single. April 27, 1899. Five hours ago struck on the head by a brick. Alcoholic, conscious, rational. Bleeding from left ear and three cuts on top of head, which on examination shows no fracture of skull. Large hæmatoma behind and below left mastoid process. Reflexes all present. Pupils dilated, but react. Condition not considered one for immediate operation. Two days later trephined, when a frac-

tured base was found. There were three distinct lines of fracture forming a triangle, leaving a large fragment of bone between the anterior and middle fossæ held in place only by periosteum.

CASE II.—J. D., forty-eight, single. July 24, 1901. Four days ago fell 35 feet, landing on some rocks. Taken to another hospital, but discharged from there the next day and walked home. Since leaving the hospital has had severe headaches, pain in back of neck, nausea, dizziness, blurred sight and gradual increasing paralysis of left arm. Good color. Both pupils contracted, but right smaller than left; react slowly. Left shoulder shows marked ecchymosis. Heart slightly enlarged, lungs negative. Left arm, above triceps, and forearm at middle show one inch atrophy; marked atrophy of left deltoid; left hand grasp diminished; hand limited in extension, as though due to contraction of flexors; hand can be flexed, but not extended.

August 9.—Patient was discharged to the Nerve Out-Patient Department. While in hospital patient complained of occasional headaches and was markedly irritable at times.

CASE III.—W. C. March 7, 1904. Four days ago, while drunk, fell down the cellar stairs. Friends say that at that time there was bleeding from the nose and mouth. Was put to bed. For the past two days has headache, vomiting, increasing deafness and mild delirium at night, but by day has sat up. Conscious; pupils contracted; react to light and distance. Left ear shows redness of drum and depression of upper part of auditory meatus. Tongue protruded to right. Marked rigidity of right lower extremity; knee-jerk present; left exaggerated; no ankle-clonus. Patient became unconscious shortly after entrance. Right pupil became dilated, but both react. Respiration became stertorous, Cheyne-Stokes in character. There was no evidence of localized cerebral lesion. Died two days after entrance.

CASE IV.—G. H., fifty-two, married. April 26, 1903. To-day, while drunk, fell down elevator shaft, two stories. Taken to Relief station. Examination shows hæmorrhage from mouth, but none from ears. Right pupil smaller than left; both react. Reflexes normal. No paralysis. Refused to be treated, and left, against advice. Four days later walked into the hospital. Mildly delirious. Left pupil larger than right; both react slowly. Knee-jerks normal. Right Babinski, marked double Kernig. Some stiffness in the neck. Temperature and pulse gradually rose;

patient became delirious, finally sinking into a stupor, and succumbed forty-eight hours after having been admitted to the hospital.

CASE V.—F. R., thirty, single. June 14, 1902. Friends state that four days ago patient fell from his bicycle, injuring back of head; wounds dressed at home by a physician. Patient up and about, appearing perfectly well, when suddenly to-day became delirious, requiring restraint. Brought to the hospital. Unconscious. Pupils react; divergent strabismus; right eye apparently the one affected. Pulse, good volume. Respiration stertorous. Right facial paralysis. Supra-orbital pressure causes free movements of arms, legs and face, but response greater in the left side than in the right. Abdominal, cremasteric and knee-reflexes present; no ankle-clonus; double Babinski. In upper part of occipital bone, median line, is a depression size of a nickel, apparently old. No bleeding from ears, nose or mouth.

June 15.—General condition has failed. Operation advised. Horse-shoe flap, right temporal region, vertical fracture near occipital end of wound running down the base, thin extra-dural clot, brain pulsating. Opening enlarged backwards, large extra Patient stood operation poorly and succumbed to death in a few hours.

CASE VI.—D. C., fifty, married. June 30, 1904. Six weeks ago was struck on the back of head by iron bar and was treated at the relief station for scalp wound, at which time there were no symptoms of fractured skull. Refused to stay in hospital. Since accident patient has had continued frontal headache; pain with dizziness; pain with vomiting without reference to meals; has grown markedly nervous and irritable. Says his sight has grown dim and his hearing is poor. Unable to sleep for the past two weeks; has felt drowsy most of the time.

Physical examination negative, except for diminished kneejerks. Ears and eyes negative. Patient was in the hospital thirty-seven days, twenty-four of which were spent in bed. For two weeks patient was mildly delirious at night and drowsy during the day. This condition gradually wore off, and the patient was discharged, relieved, to the Nerve Out-Patient Department. (There is no positive sign that this case was more than cerebral contusion, but we believe our conclusions (*vide infra*), nevertheless, cover it.)

The cases here cited have been personally observed by us. In each one there is apparently warrant for the belief that the patient would have done better if he had been in bed under the right conditions from the time of the injury.

CASE VII.—April 10, 1900, P. H., a soldier, from a harbor fort, was found on the sidewalk after a fall from assault or accident. Unconscious; bleeding from left ear, hæmatoma behind it; left pupil larger than right, but both react sluggishly; no paralysis. Consciousness returned in a few hours, bleeding stopped, the pupils became normal, and the patient was quite without symptoms on the third day. On the fifth day, against advice, patient insisted on leaving the hospital, boarded the steamer and got to the fort, stepped ashore there and dropped dead. Autopsy showed a fracture of the base; details not obtainable.

This case alone, it seems to us, is enough to warrant the contention that fracture of the base should at least be treated with the conservatism which goes with the care of other fractures. Although these fractures are not open to the eye or the finger, they are even more liable to mobility and consequent injury of delicate adjacent parts than are fractures of the skeletal bones. Although fixation of basal fractures is not possible by any accurate application, because in the first place the line of fracture is not known, and in the second place may extend in several directions, it is nevertheless presumptive that a patient in bed would be less liable to jar or other kinds of force which might stir up the fracture or dislocate clots.

We, therefore, strongly urge as routine treatment in all cases of even suspected fracture of the base of the skull, rest in bed for full three weeks. Such a patient ought to be in a separate or small, dimly-lighted room, where little can attract his attention. He should have a single low pillow, or none, as he prefers. He should have as few visitors as possible, should take nourishment still lying down, and have practically nothing to attract his attention or to cause any excitement. Food should be easy to digest, cathartics should be used freely to

prevent the least strain at stool, which causes cerebral congestion. Headache should be controlled by whatever sedative seems to work best in the given case and used even to an extent to keep the patient more or less somnolent.

This utmost conservatism in the care of these cases must help to prevent startling deaths such as have been here described. Treatment which only keeps the patient in bed till his whim demands that he get up is not rational or careful treatment. The fracture exists even if the patient feels perfectly well. A bone will not heal in three days.

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ON THE TECHNIQUE OF OPERATIONS UPON THE HEAD AND NECK.

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I WISH at once to restrict the rather too broad title of this paper to a consideration of the control of hæmorrhage in various operations upon the head and neck, and a discussion of the plan and extent of dissection in cases of malignant tumors.

Hæmorrhage.—Arterial and venous hæmorrhage are best considered separately. In the first stage of the operation for excision of the Gasserian ganglion, arterial hæmorrhage is of paramount importance; in the second stage, venous and capillary. In the excision of a goitre, venous hæmorrhage is more important than arterial. In most operations both factors are present. Surgical practice is at present divided as to the means of controlling each. In one clinic the patient is operated in the head-up posture, in another in the head-down posture, in another in the horizontal. Some surgeons in important operations place a permanent ligature upon the external carotid, others apply various methods of temporary closure, while still others depend upon local hæmostasis without any control over the main blood-supply. One still sees the practice of the older surgeons, consisting of a dashing operation, followed by quick packing and securing of vessels, disregarding for the moment the loss of blood. Obviously the methods of control of the arterial and venous hæmorrhage are almost diametrically opposed to each other. We will, therefore, first consider the control of the arterial hæmorrhage.

Four distinct methods may be considered. First, that of head-up posture, thereby diminishing the blood-pressure and the flow of arterial blood to the operative field. This

method is helpful, but, as frequently practiced, if the patient be under full anæsthesia, is attended with the danger of sudden and not-easily-controlled cerebral anæmia, because of the circulation not being sufficiently under control. If, on the other hand, the patient be not under full surgical anæsthesia the surgeon may be seriously hampered in his efforts at precise dissection. The risks on the one hand and the shortcomings on the other leave much to be desired by this method.

Second, permanent ligature of the external carotid artery. A study of the literature of this subject will show between two and three per cent. mortality from cerebral embolism alone. In many cases of malignant diseases of the neck the exposure and tying of this vessel requires dangerous handling of malignant tissue. The definite and needless risk of cerebral embolism and its danger in many malignant diseases seriously handicaps this procedure.

Third, the control of hæmorrhage from point to point by means of artery forceps. By this method a comparatively bloodless operation may be performed, but the objection to its employment is the laborious task of picking up so large a number of vessels in the major operations of the neck, thus requiring an increased length of time, and becoming a decided factor in the production of shock.

Fourth, the temporary closure of the common carotid or the external carotid, in the head-up inclined posture, the securing of each vessel as it appears, and the application of the pneumatic suit to prevent cerebral anæmia. This method embraces the points aimed at in the three preceding. The carotid is closed only temporarily.

In certain operations upon the scalp in which the division of this tissue is extensive, the blood-supply abundant, and perhaps in addition it is especially desirable to maintain a dry field, a very satisfactory anæmia on the plan of the Esmarch bandage may be obtained by the use of a double layer of rubber dam, this to be applied snugly upon the entire scalp, covering every part of the head, rendering the scalp completely bloodless. The free end may be tucked under like the

application of a turban, and the incision may then be made through the rubber dam, the latter affording a splendid protection to the operative field. This is in many respects more practical than the elastic tourniquet placed around the base.

Venous Hæmorrhage.—Aside from the use of a rubber dam turban as above described, we have no other means for general purposes for the control of venous hæmorrhage than that of the head-up posture. Venous blood-pressure is so responsive to posture that during anæsthesia one may readily develop even a negative pressure in an exaggerated head-up posture. It is true that the venous blood must still flow through the vessels and the veins will still bleed, but the tension in all vessels being much lowered, and in the larger ones becoming sometimes *nil* or negative, the amount of hæmorrhage on division of the veins is greatly diminished. The head-up posture under full anæsthesia presents two dangers which must be obviated. The first is air embolism; the second, cerebral anæmia. Air embolism can be avoided by accurate dissection, which is greatly favored by the clearer field afforded by the head-up posture and the closure of the main arterial supply. I have not seen an instance in my own experience. The dangers of cerebral anæmia may be virtually overcome by the employment of the author's rubber suit. (Fig. 1.) With the application of this suit the lower extremities and the trunk up to the costal borders may be so readily compressed that the possibility of the gravitation of too great an amount of blood into the splanchnic area and large vessels of the extremities may be excluded, and the dangers of cerebral anæmia virtually obviated.

In grave cases, by having an assistant skilled in the use of the sphygmomanometer make repeated estimations, the condition of the blood-pressure may be kept constantly in mind. A fall in the pressure below 90 mm. may in general be considered a signal to raise it by increasing the pressure in the pneumatic suit.

In operations upon the mouth, such as the excision of neoplasms involving the jaw, the mouth, the buccal mucosa,



FIG. 1.—Rubber pneumatic suit in use.



FIG. 2.—Tubage of the pharynx for use in anæsthesia.

the floor of the mouth, the tongue, the hard and soft palate, the tonsils, and in cleft-palate operations, a simple method of tubage of the pharynx (Fig. 2) heretofore described, but more recently elaborated, has proven most satisfactory.

In operations upon the neck, face, and mouth, the factor of hæmorrhage, when the foregoing methods are fully employed, is almost wholly eliminated. There are several procedures, however, that demand special consideration. The first of these is the operation for excision of the Gasserian ganglion. This operation has justly acquired the distinction of being one of the most difficult in surgery almost wholly on account of the factor of hæmorrhage. In a personal experience in eighteen cases of excision of the ganglion I have had the opportunity of comparing various methods for the control of hæmorrhage. In the last eight cases the factor of hæmorrhage from the standpoint of its constitutional effect, and almost equally so from the standpoint of the obscuring of the field of operation, has been literally obviated. We have been able to do this operation with so little blood-loss that we have classed it with the comparatively bloodless operations. Quite as satisfactory has been the technic from the viewpoint of a clear field. We have been able to keep in view the ganglion from the beginning to the end of the operation, dividing all the branches and the posterior root in plain sight with scissors. The plan is as follows:

The patient is given a hypodermic injection of morphin and atropin thirty minutes before the time of operation. A skilled anæsthetist is provided. During the administration of the anæsthetic the pneumatic rubber suit is applied. After the patient is under surgical anæsthesia he is placed in the head-up inclined posture at an angle of 45° . (See Fig. 1.) This posture will cause a striking blanching of the face and neck. The common carotid artery is closed temporarily with the author's clamp and the rubber turban applied. We have now been secured against serious hæmorrhage from the scalp, brain and dura. The middle meningeal gives us no further

concern. It is a matter of no special consequence by what route we enter the skull so long as sufficient room is secured for the further technic. After the excision of the bone is completed and the dura exposed, the remaining source of hæmorrhage is venous. Innumerable small, thin-walled veins are opened at every turn. The oozing, while not rapid, is under ordinary circumstances just sufficient to constantly obscure the branches and the body of the ganglion. The control of this hæmorrhage, then, is the key to the entire situation.

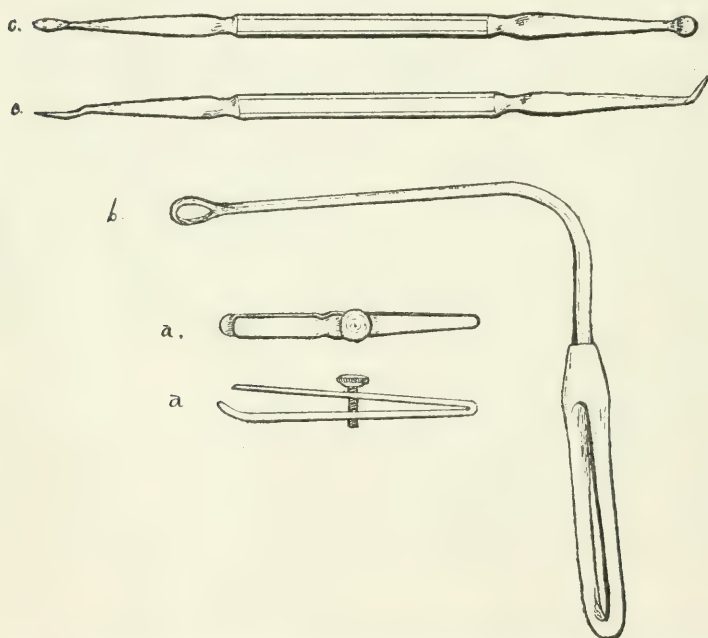


Fig. 3.—Special instruments for use in removal of the Gasserian ganglion. aa, clamps for temporary compression of the common carotid artery; b, ring retractors for venous compression; c c, blunt dissectors for elevating the ganglion.

Such control has been very satisfactorily accomplished by means of simple little retractors made of wire loops, in form like tongue retractors, the slender handles bent at right angles. Three or four of these may be required. The purpose of these retractors is that of pressing the end of a roll of sterilized gauze one inch wide, made of two layers folded in

so as to control loose threads. By means of these small wire-ring retractors and the little rolls of gauze a pressure zone surrounding the field in which the ganglion lies is established. This causes a local circular anæmia and the instruments are not in the way of the operator. As fast as the operation is advanced—*e.g.*, exposure and division of the third branch, the second, then the first, and the ganglion further raised up by means of a special little instrument, the small pieces of gauze are advanced and held firmly down by the retractors, thereby keeping the hæmorrhage constantly under control. During the latter part of the operation the field is as dry as that of a herniotomy. After a sufficient experience on the part of the operator and almost equally on the part of the first assistant, it is almost impossible to imagine any instance in which the hæmorrhage could not be controlled or the ganglion kept in sight and the entire dissection made under the eye.

The operation is usually completed within an hour. The patient during the operation will require but little anæsthesia. The brain anæmia and the morphia are in themselves almost sufficient, so that when the clamp is removed from the carotid and the patient again placed in the horizontal posture he comes out of the anæsthetic very quickly.

In the operation for cleft palate the use of the rubber tubes with packing of the pharynx permits the operator to work as continuously in this field as in a herniotomy or in an amputation. Furthermore, the patient does not inhale any blood. It is necessary here, however, to urge great care in packing the pharynx so low down as to give working space in the soft palate.

In excision of the tongue the same rule holds, the question of hæmorrhage becomes a very simple matter and the dissection can be carried on with the deliberation and care that is so necessary in an operation for excision of cancerous growths. The greatest advantage in the operative technic by the posture, the closure of the artery and tubage of the pharynx is experienced in excision of the tonsil for malignant disease. The operation is begun on the outside, a straight

incision being made over the sterno-mastoid. If any glands are enlarged a block dissection is made up to that point, and, finally, if the operation is to be done at one stage, a gloved forefinger is put inside the mouth so that bimanually the exact line of limitation and excision can be made out. The dissection then can be carried with the greatest precision straight through into the mouth and pharynx and the tongue separated without blood loss and without one drop of blood being inhaled into the broncho-pulmonary tract.

In laryngectomy, after the preliminary tracheotomy has been made, the inhalation of blood may be here absolutely avoided by passing a rubber tube of the simple respiration apparatus, similar to that used in the tubage of the pharynx heretofore alluded to, the tube being made to fit as closely as possible in the tracheotomy opening. The elasticity of the rubber tube and equal elasticity of the granulations which have moulded about the tracheotomy tube together with the vaseline applied upon the tube, make a watertight connection. However, it may not be entirely so and there may be reasons for removing this tube during the operation. It is best, therefore, to throw up a horseshoe flap of skin around this tube so as to make a gutter or drain, protecting the tracheotomy tube from the possibility of the entrance of any blood. The larynx may then be removed with as much deliberation, and certainly as independently of the anæsthetic and the anæsthetizer, as in any operation upon the extremities. When finally the trachea is to be divided there is even then no necessity of permitting the inhalation of any blood from the capillary oozing of the divided trachea.

Plan of dissection in the excision of malignant tumors.—From the development of the principles underlying the control of hæmorrhage and the management of the anæsthetic it seems to me that we have reached the strategic position in the technic of operations for cancer of the head and neck which permits us to at once lay aside all the conventional procedures and operate each case as a straight dissection referable only to the complete

excision of the primary focus and the metastases or probable metastases.

A rough-and-ready operation whereby a maxilla is torn out, the tongue lacerated, and tissues are crushed and bruised, while the patient is alternating between over-anæsthesia, and struggling, and inhaling blood (the conventional operation of the past), is substituted by a plan of quiet, continuous dissection in a clear field with little or no blood-loss. We should be able to perform operations upon the head and neck with precisely the same thoroughness, the same gentleness, in handling the infected tissues, as in cancer of the breast.

The lymphatic vessels are largely the determining factor in planning the technic for operations in malignant diseases. We are entirely justified in assuming that cancer is always in its beginning a local disease, and each case then must have a curable stage. In the earliest stage, when it is only just beginning, local excision may be sufficient, but it is safer to always remove the lymphatic bearing tissue immediately draining the focus. If, however, the cervical lymphatic glands are once involved by cancer metastases, then it matters little what the original source of the metastasis was, whether of the lip, the tongue, the cheek, or tonsils, the whole group of glands and gland-bearing tissue of that side of the neck should be sacrificed, and the key to the dissection is the sacrifice of the internal jugular vein. This vein is physiologically readily compensated for. Its excision is simple. If one tries to save the internal jugular they subject the patient to the great risk of having cancer-tissue manipulated and of leaving behind certain small glands or vessels in which cancer-cells may be lodged. When once a lymphatic gland is blocked and choked with cancer metastases, the further metastases may go in any direction. They may go back stream or by side anastomoses. It is necessary to remove the entire lymphatic-bearing tissue lying between the deep muscular planes of the neck, in which there are no lymphatic glands, and the platysma and skin, in which there are likewise no lymphatic glands. Starting from below upward, the internal jugular vein as well as the super-

facial and the deep cervical fascia are divided, and when once the operation is well established in the deep plane of the neck the dissection from thence upward is simple.

Since adopting the radical bloc dissection the percentage of three-year cures have been more than quadrupled.

This paper is based upon experimental researches which have been heretofore published, and a clinical experience in 734 operations among which may be mentioned the following: Excision of Gasserian ganglion, 18; thyroidectomies, 108; trephining, 113; malignant tumors, 174; tubercular glands, 74; harelip and cleft palate, 28.

THE BONE METASTASES OF HYPERNEPHROMA.

A REPORT FROM THE MASSACHUSETTS GENERAL HOSPITAL CLINIC.*

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PREVIOUS to 1883 new growths of the kidney were not very accurately differentiated. Lipoma, sarcoma, adenoma, adenocarcinoma, angioma, angiosarcoma, myxoma, endothelioma, were a few of the terms applied to kidney tumors.

In 1883 Grawitz¹ described a tumor of the kidney similar in structure to the adrenal and traced its origin to adrenal tissue.

Birch-Hirschfeld, in 1896, called these tumors arising from adrenal tissue, hypernephromata. The term hypernephroma, therefore, is applied to all tumors of adrenal origin. They may arise either from the normally-seated adrenal body or from ectopic fragments of the adrenal body, the so-called adrenal rests. Because of the very intimate developmental association of the adrenal body and the genito-urinary apparatus bits of adrenal tissue are frequently found included within certain organs, notably the kidney, the ovary, the testicle, the uterus. Thus is explained the occurrence within these organs of tumors resembling adrenal tissue.

In size, a hypernephroma may be as small as a pea or as large as a child's head. It is not uncommon to discover, at autopsy, tiny adrenal kidney rests which have remained in the kidney without causing symptoms. A hypernephroma, developing slowly in the kidney, may remain symptomless for years. Finally it may grow rapidly and become malignant.

* NOTE.—I wish to thank my colleagues of the Surgical Staff who have permitted me to record here cases occurring in their hospital services.

¹ Virch. Archiv., xciii, 39, 1883.

Malignancy manifests itself in three ways: (1) By local destruction of tissue after breaking through the capsule; (2) by metastases; and (3) by a general toxemia.

The important symptoms and signs of a hypernephroma are hæmaturia, renal colic and tumor.

Hæmaturia is occasioned by hæmorrhage from the new growth which has extended into the pelvis of the kidney. Hæmaturia is variable in time and quantity. Hæmaturia appears at intervals and lasts but a short time. The absence of hæmaturia does not mean that the kidney is free from the growth. In the case here recorded hæmaturia is absent and yet the tumor is present.

Renal colic is caused by the passage of ureteral blood clots. Pain may be occasioned by the stretching of the tumor capsule. In the case here recorded there has been no pain referable to the kidney or loin. The tumor may be discovered, as in the present case, before any other sign of the kidney lesion is present. The general pallor of the present patient is characteristic. Blood changes, other than a low hæmoglobin, are not present.

The metastases of the hypernephromata are most interesting. Neusser calls attention to the fact that apparently benign hypernephromata are capable of giving rise to metastases larger than the primary growth. Metastases are found most often in the lungs, the liver and the bones. Almost any of the tissues of the body may be invaded. It is generally thought that the mode of metastasis is through the blood by way of the renal vein. Extension is thought to occur rarely through the lymphatics. Many specimens exist in which the growth is seen extending directly into the renal vein.

In my service at the Massachusetts General Hospital, during the past three years, there have been three cases of hypernephroma. I wish to record in detail one of these cases (Case XI of the M. G. H. series) as it is of especial interest:

CASE XI.—Massachusetts General Hospital, No. 144,138.

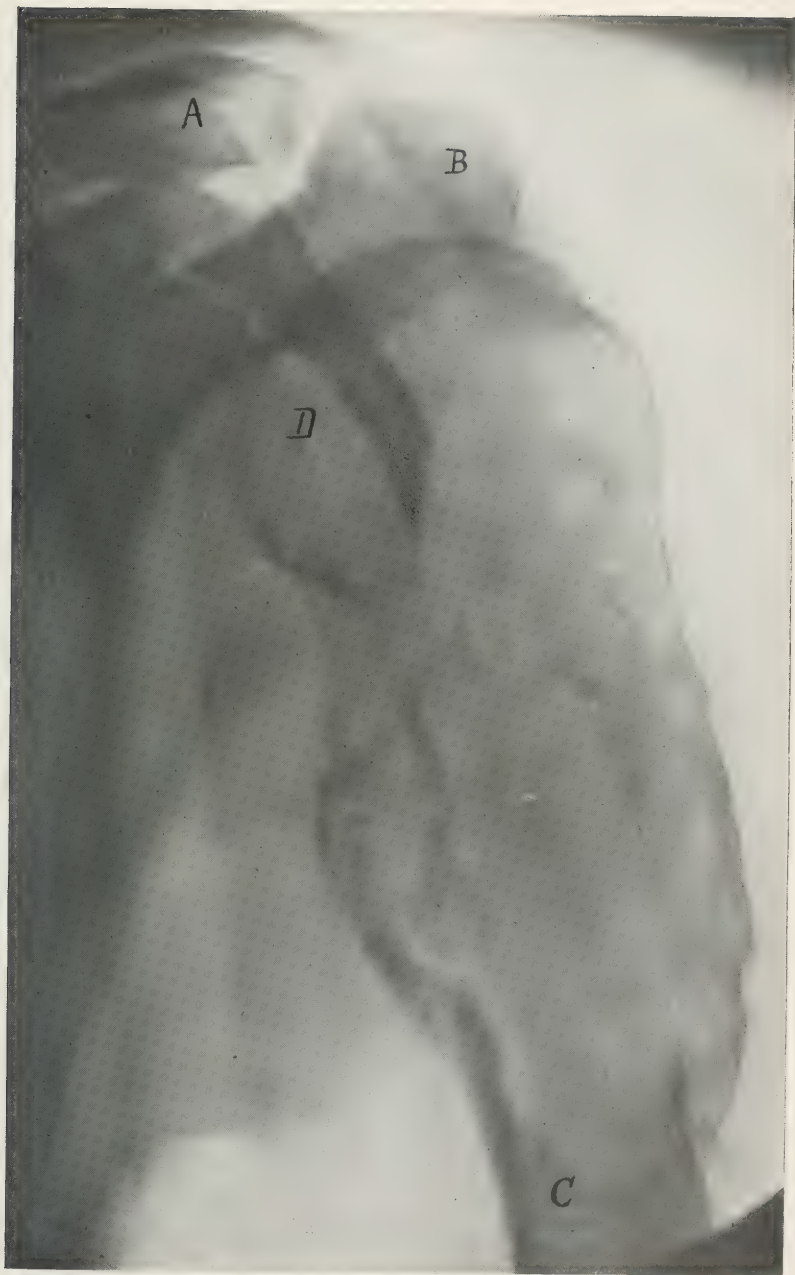


FIG. 1.—Case XI: X-ray of upper end of humerus, showing region of tumor, D, C. A, Clavicle; B, Acromion; C, Shaft of humerus; D, Head of humerus.

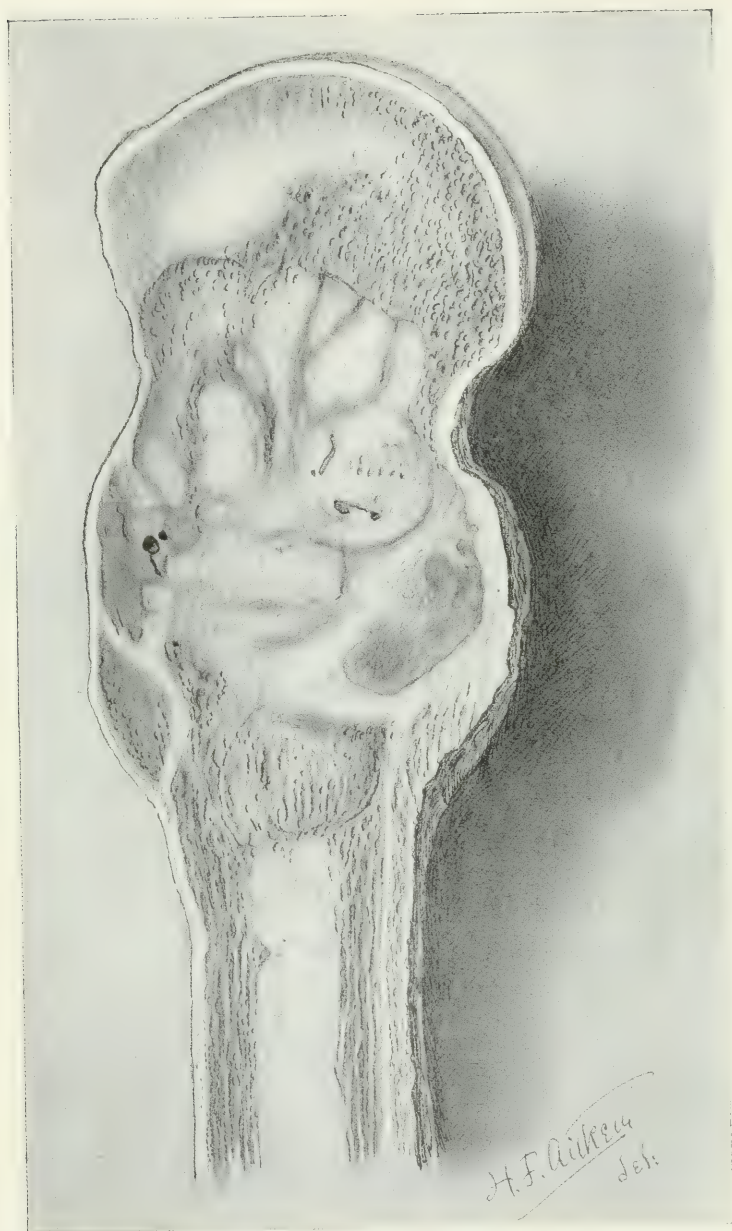


FIG. 2.—Case XI: Hypernephroma, metastatic in upper end of the shaft of the right humerus.
Drawing made from a section of the gross specimen.

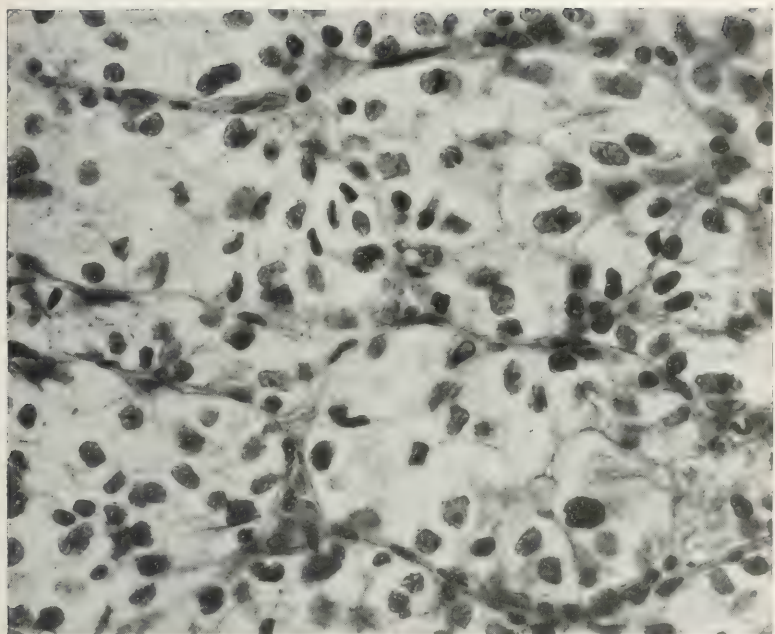


FIG. 3.—Case XI: Microphotograph of a section from metastatic hypernephroma in upper end of humerus. Oval polygonal cells—preservation of rim of cytoplasm, deeply staining nucleus, perinuclear lightly staining spaces. Microphotograph by Mr. Brown, M. G. H. Laboratory.

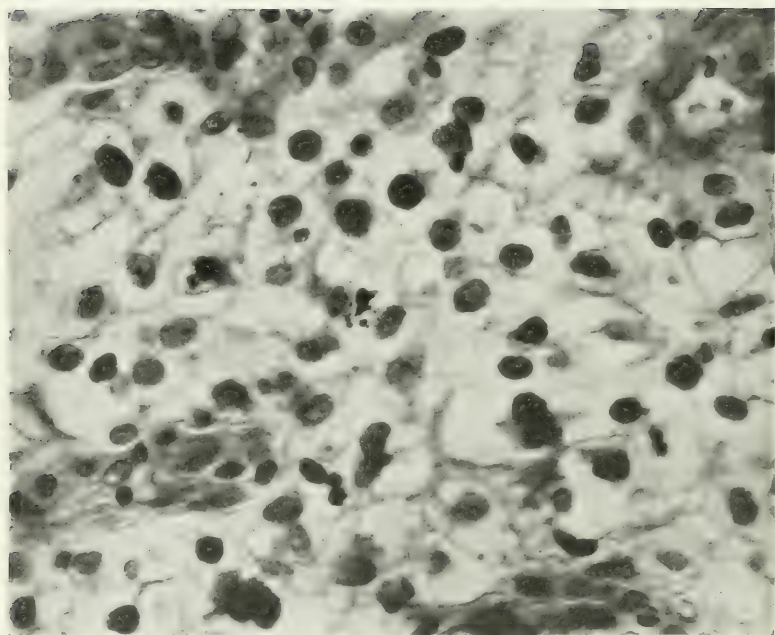


FIG. 4.—Case X1: Microphotograph of a section from metastatic hypernephroma in upper end of humerus. Higher power than in previous plate, No. 3.

September, 1905. J. J. A., a man thirty-four years old. Has always been well and strong. For eleven months he has had pain and discomfort about the right shoulder joint. The shoulder has been sore and stiff. The impairment of motion has been in the extremes of movement. There is an atrophy of the scapular muscles. At the upper end of the shaft of the right humerus is a tumor, which is not particularly tender upon pressure.

The X-ray defined the tumor accurately. (See Figure 1.) Before operation it was thought to be a sarcoma of the humerus. An amputation at the shoulder joint determined that the joint was uninvolved by the disease. The microscopical report discovered that the growth was a hypernephroma. (See report.)

Palpation of the abdomen after operation discovered for the first time a slightly movable and enlarged left kidney. There were no signs or symptoms attracting attention to the kidney. The urine was normal.

The man recovered from the operation. Recent examination one year after the operation finds the man in fair health and about as well and strong as usual, although he is extremely pale and cachectic-looking.

Pathological examination and report by Dr. C. C. Simmons. The specimen consisted of the whole upper extremity, including the head of the humerus (see Fig. 2). On section at the surgical neck there was a fracture through the tumor mass. Occupying the shaft beneath the surgical neck and extending from the head downwards for 6 cm. was a soft grayish-white new growth which had distended the medullary canal and absorbed the greater part of the cortex. The bone at the center of this growth was 5 cm. in diameter. No infiltration of the soft parts could be made out, and the growth did not involve the shaft of the bone below the site of the main tumor.

Microscopic examination (see Figs. 3 and 4) showed solid masses of large round cells having an alveolar arrangement and separated by many fine blood-vessels and fine bands of fibrous tissue. The cells were round, with somewhat vesicular nuclei and a comparatively large amount of clear, fatty degenerated protoplasm having a definite outline. The tumor represents a sarcoma and is highly suggestive of metastasis from a hypernephroma. Sarcoma (hypernephroma).

It was thought, at the time of examination and previous to

operation, that this tumor of the upper end of the humerus was a sarcoma.

In a paper, "A Study of Certain Cases of Sarcoma of the Long Bones, from the Massachusetts General Hospital Clinic," published in the *Boston Medical and Surgical Journal* in June, 1904, the conclusion was reached that in cases of sarcoma, amputation at the joint above the disease is wise, if the disease is high in the shaft, and limited. Consequently, in this case amputation at the shoulder joint was done. A fact of interest connected with this case is that the tumor of the humerus was the first evidence or sign of the disease.

Certain questions of practical importance arise: What is the proper attitude toward this kidney-tumor, as yet manifesting no sign? Shall it be removed by nephrectomy? If it is removed what will be the prognosis?

The very great proneness of the hypernephromata to metastases, as demonstrated by autopsy reports and the fact that the metastases are usually multiple, would lead one to give an unfavorable prognosis in this case were it not for a series of very careful observations by Albrecht² from Hochenegg's clinic in Vienna.

Albrecht finds that in two cases of Hochenegg, in which complete autopsy returns have been made, the bone metastasis was the *sole* metastasis. This observation is of importance. These cases were as follows:

Hochenegg (reported by Albrecht), Case II, a *skull sarcoma* was operated upon and died. A complete autopsy showed no other metastases. Case V, a nephrectomy. Four months following the nephrectomy a metastasis appeared in the *occipital* bone, and six months after the appearance of this metastasis a complete autopsy found no other metastases.

In view of these observations of Albrecht it is possible that in the case reported the metastatic growth in the humerus is the only metastasis present. If so, nephrectomy is indicated.

² Arch. f. klin. Chir., 1905, lxxvii, 1073; with bibliography.



FIG. 5.—Hochenegg's Case No. 4: Reported by Albrecht. 60 years old. Radiograph. Hypernephroma of femur. Spontaneous fracture of femur. Amputation of thigh. 5½ years subsequently tumor of kidney apparent. Complete autopsy. Metastases elsewhere.

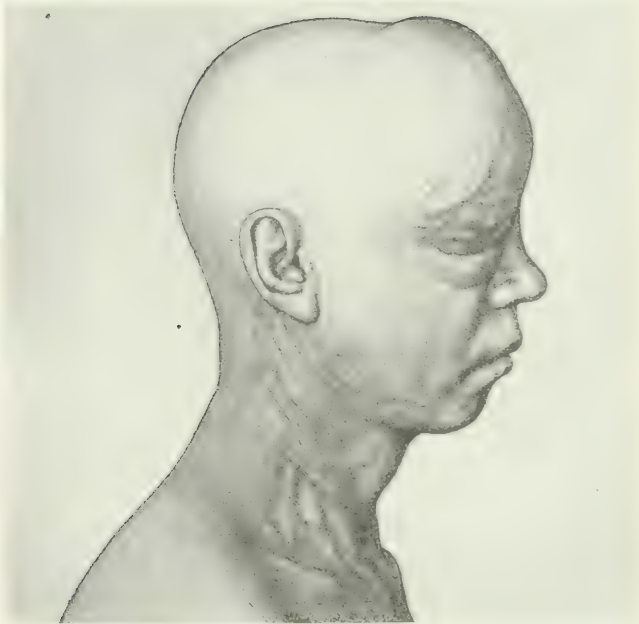


FIG. 6.—Hochenegg's Case No. 7: Reported by Albrecht. 42 years old. Hypernephroma of parietal and frontal bones. Death, complete autopsy.

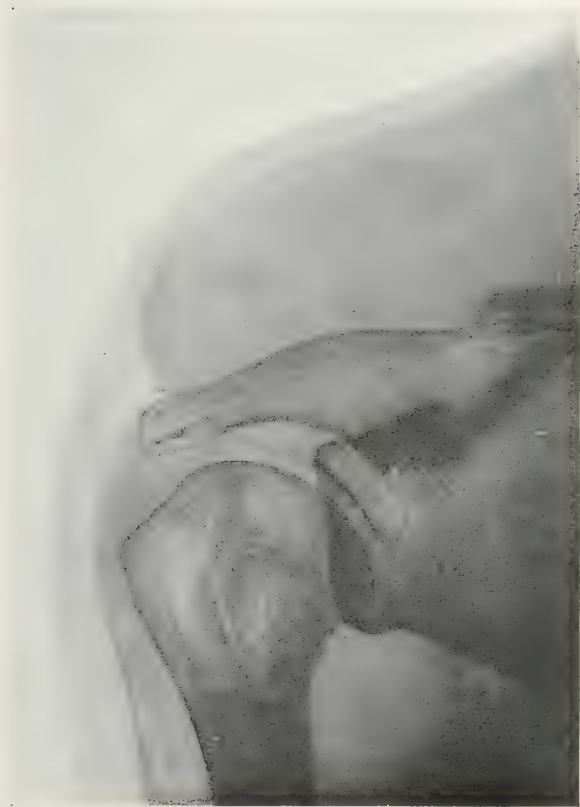


FIG. 7.—Hochenegg's Case No. 16: Reported by Albrecht. 65 years old. Radiograph of hypernephroma of clavicle.

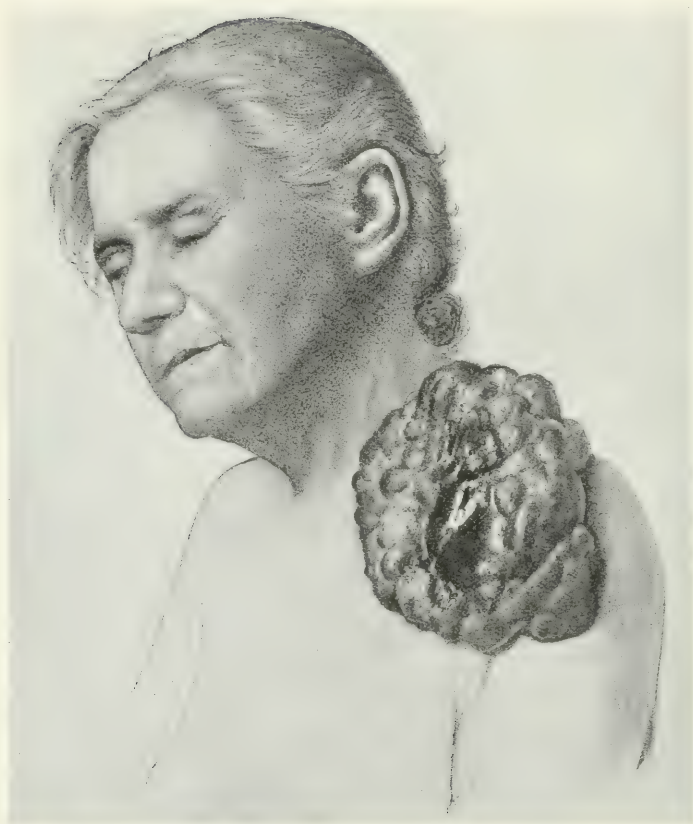


FIG. 8.—Hochenegg's Case No. 16: Reported by Albrecht. 66 years old. Hypernephroma of clavicle recurrent.

In collecting and studying certain of the cases of hypernephromata which have appeared at the Massachusetts General Hospital Clinic, I find, all together, eleven cases. A careful microscopical study of each of these cases was made by Dr. Whitney or Dr. Wright or Dr. Simmons. The end results are known in all of these cases. Excepting the case here recorded, all of these patients are dead or are reported (two of them) dying. Such is the mortality of the malignant hypernephromata!

Bone metastases were present in three of these cases, in addition to the case here recorded in detail. In one case the metastasis was in the frontal bone and humerus—Case II. In another case the metastasis was in the humerus—Case X. In the third case the metastasis was in the femur—Case IX.

Albrecht records four cases with bone metastases, besides the two cases already mentioned in which the bone metastases were the sole metastases. These four cases with bone metastases were briefly as follows:

(The numbering of these cases corresponds to Albrecht's series.)

IV. A woman sixty years old presented a spontaneous fracture of the *left femur*. An amputation was done in the upper third of the thigh for sarcoma of the femur. Recovery from operation; five and a half years later a kidney tumor, hypernephroma, was discovered; complete autopsy was done. The urine was always negative. (See Fig. 5.)

VII. A man forty-two years old presented *frontal and temporal bone* hypernephromata. An attempt was made to remove the growth. He died after operation. Autopsy discovered a hypernephroma. The urine contained albumin. (See Fig. 6.)

XV. An adult, forty-eight years old, presented what was thought to be a fungus disease of the *knee-joint*. The thigh was amputated. Death occurred. The tumor proved to be a hypernephroma metastasis. The urine contained some leucocytes and cells which might have been interpreted as tumor-cells.

XVI. A woman, sixty-six years old, presented what was thought to be a cold abscess over the *clavicle*, with a tubercular periosteitis. An attempt at removal was followed by recurrence and death. A complete autopsy discovered a hypernephroma and microscopical examination demonstrated the tumor of the clavicle to be a hypernephroma metastasis. The urine contained a few leucocytes. (See Figs. 7 and 8.)

There are five other cases of bone metastases in literature,

viz., Loewenhardt,³ from Helferich's clinic, reports a *clavicle* metastasis resembling Hochenegg's Case XVI; von Bergmann's clinic⁴ reports a pulsating *tibial* tumor; Israel⁵ reports a case in which the metastases in the *rib* and *thigh* were the first signs of hypernephroma. Küster⁶ reports two cases in which the metastasis was the first sign in one case in the *calvarium*, and in the other case in the *rib*.

So far as I have been able to determine there are, therefore, recorded of bone metastases, six cases from Hochenegg's clinic, five cases from literature, and four cases from the Massachusetts General Hospital clinic, fifteen cases altogether. There are doubtless other cases, but none in which the records are complete or the authority satisfactory.

The practical suggestions from this review of the metastases of the hypernephroma are: A bone metastasis may be the first sign of a hypernephroma. A bone tumor in a middle-aged or elderly person should suggest a metastatic hypernephroma, for a primary bone tumor in elderly people is uncommon. The bone metastasis from a hypernephroma may be the only metastasis. A hypernephroma may exist without symptoms for a considerable period. The kidney region should be palpated with great care in every case of tumor of bone.

A very complete bibliography is to be found at the end of the paper by Keen, Pfahler and Ellis in *American Medicine*, vol. viii, No. 25, December 17, 1904.

Thorndike and Cunningham present a valuable paper upon hypernephroma in the *Boston Medical and Surgical Journal*, vol. cxlix, No. 23, pp. 611-616, Dec. 3, 1903.

MASSACHUSETTS GENERAL HOSPITAL CASES OF HYPERNEPHROMA.

CASE I.—*Hypernephroma (left), hæmaturia, lumbar pain, nephrectomy. Recurrence in loin five years later. Death. J. R.*

³ Deutsche Zeitschr. f. Chir., bd. 28, 1888.

⁴ Verhandlungen des 16 Congressen der Deutschen Gesellschaft f. Chir., 1887.

⁵ Archiv. f. klin. Chirurg., bd. 47.

⁶ Deutsche Chirurg., 1896-1902.



FIG. 9.—Case No. 1: Recurrent hypernephroma of loin.

O., a man, forty-nine years old and married. M. G. H. records, vol. 338, p. 143, and vol. 512, p. 57, 1898. The patient has had indefinite pain in the back for a long time. Two months ago he had a painless hæmaturia, lasting four days. One week later he had hæmaturia again, this time with clots in the urine and severe pain in the left lumbar region requiring morphia. The left kidney was found enlarged and sensitive. Two weeks ago he again had pain in the left lumbar region, requiring morphia for two days.

The patient is well developed and nourished. The heart and lungs are negative. On bimanual palpation of the left lumbar region the kidney can be palpated with difficulty. There is a little tenderness over the left kidney. The X-ray shows a slight haziness upon the left side, but no calculus. Urinary examination: normal; acid, 1016; albumen, $\frac{1}{10}$ per cent. Sediment normal blood, much pus, free and in clumps, few squamous cells.

Operation by Dr. F. B. Harrington. Nephrectomy.

Pathological Report.—The specimen consisted of a kidney, and extending from one extremity downwards, filling up the hilus, is an irregularly-shaped mass the size of an orange, arising from the adrenal body. On section this showed numerous cysts, some of which contained blood, others a clear fluid. Numerous areas of fatty degenerated adrenal tissue appeared. The diagnosis of sarcoma was made at this time.

In 1905, almost six years following the nephrectomy, the patient complains of pain and persistent hæmaturia. Up to a year ago he felt pretty well. One year ago he had noticed a swelling at the site of the wound and pain across the back, which sometimes shoots down into left thigh. Both pain and swelling have increased very much this past year.

The palpable and visible tumor is shown in the photograph (Fig. 9). A piece was removed for examination in the service of Dr. Scudder.

Pathological report of recurrence in loin June 6, 1905. Two pieces of tissue, the largest, 3x2 cm. in diameter, consisting of skin and subcutaneous tissue, in which was a nodule of grayish-white growth.

Microscopic examination by Dr. W. F. Whitney shows an alveolated structure, with spaces filled with large cells with a clear body and a relatively small, dark, deeply-staining nucleus.

Diagnosis.—Secondary hypernephroma. This patient was sent home to die from the hospital.

CASE II. *Hypernephroma (left). Many metastases. Excision of frontal bone tumor. Blindness. Death.* A woman, forty years old and married. M. G. H. records, vol. 429, p. 189, and vol. 435, p. 13, 1903. The patient has had no serious illnesses. For six years she has had headaches, which have been very severe for the past year. She has had no nausea. For six months she has had vague "mental symptoms." Four months ago there appeared a swelling over the left frontal eminence, the size of a small egg. The frontal tumor was removed yesterday by her doctor, who found an opening from it into and through the frontal bone. Great hæmorrhage. Sent to the hospital.

The patient is a pale, thin, nervous woman. Reflexes present. Heart rapid, no murmurs, no enlargement. Lungs negative. Further operation is thought inadvisable, as the wound is healing. It is thought that the growth might have been specific in character. Given iodide of potash.

Examination of the urine; pale, acid, 1023, slightest possible trace of albumen, sugar absent; sediment, a rare granular cast, some small round cells, abundant squamous epithelial cells, many uric acid crystals.

A small, firm lump has recently appeared over the right eyebrow. It is not tender. She was discharged from the hospital without operation. One month later, in April, 1903, she reëntered the hospital.

At the seat of the old operation is a bluish, fluctuating tumor the size of an English walnut, slightly painful upon pressure. Over the right eye is a tumor, described above, slightly movable, about the size of a small marble. On the right parietal bone is a third similar tumor of smaller size. An indefinite mass can be felt in the left side of the abdomen under the costal border, which is slightly tender on pressure. The chest on the left side is dull to the eighth rib in the axillary line. The deltoid muscle of the left arm is considerably atrophied. Upon the left shoulder, in the region of the great tuberosity of the humerus, is a hard, rounded tumor about the size of a small egg. The tumor is not painful upon pressure. There was no relief from X-ray treatment. All the tumors were increasing in size. The patient was anxious to have an operation.

The tumor over the right eye was removed by Dr. M. H. Richardson. The growth was found to have perforated the frontal bone.

The patient lost in strength, and about three weeks after the operation died, totally blind, April, 1903.

The left chest was flat to the fifth rib in the axillary line. There was a high temperature.

Report by Dr. J. H. Wright from the Clinico-Pathological Laboratory.—The specimen received for examination contains several small tumors, the largest about 7 mm. in diameter and situated in what seems to be subcutaneous connective tissue. The tumors consist of closely packed cells of atypical character, having vesicular nuclei and considerable cytoplasm. A good many small blood-channels permeate the tumors. Some of these appear to be lined with a delicate endothelium. The tumors are regarded as sarcomatous in character and not inconsistent with hypernephroma.

CASE III.—M. H., a woman, forty-one, single. June 5, 1903. M. G. H. records, vol. 442, p. 203. The patient has been running down in general health for the past two years. She worked up to one year ago. Eight months ago she noticed a "lump" in the left side, which has grown steadily larger. No pain is felt in this "lump." For the past three weeks her belly-wall has been tense. She has lost much weight. There has been frequency of micturition during the past few months. She has had to sit erect at night in order to breathe with ease.

Patient is a poorly developed and nourished person. A presystolic heart-murmur is heard, which is transmitted into the axilla. The chest is apparently normal. The abdominal walls are tense. The abdominal tumor is about the size of a twin pregnancy at term. The girth is $42\frac{1}{2}$ inches. There is a fluctuation wave over the whole abdomen. All the pelvic structures are pushed down into the pelvis.

June 6, 1903. Operation. Nephrectomy by Dr. C. L. Scudder. Six to eight quarts of a free brownish fluid in the abdominal cavity. Colon displaced toward median line.

Death June 10, 1903, five days after the operation, due to weakness and shock.

Pathological report by Dr. W. F. Whitney.—A kidney, in which was a very large new growth, which weighed 2280 grams. On section it was very soft, medullary in character, and of a rather variegated surface, in which yellow and red extensively predominated. The kidney was about half destroyed and into

the pelvis of the kidney projected masses of new growths, as well as into the lumen of the renal veins.

Microscopic examination June 6, 1903, showed a reticulated fibrous structure, among which were large cells with rather clear protoplasm and large nuclei and nucleoli.

Diagnosis.—Hypernephroma.

CASE IV.—M. M. R., 40 years old, a widow. June 21, 1904. M. G. H. records, vol. 46, p. 108. She has always had fair health. Last year, before Christmas, the patient first noticed a dull, constant pain in the region of the left kidney, sometimes shooting into both groins. The pain sometimes caused vomiting. Frequency of micturition at night and a very great variation in the amount of urine passed upon different days has been noticed by the patient ever since the beginning of the pain. She has lost weight for the past six months. The abdomen is not distended. Below the floating ribs upon the left is an area of marked tenderness which corresponds to a tumor of the left kidney.

Operation.—Nephrectomy by Dr. W. M. Conant. A hard mass was felt in the lower end of the kidney. The renal vessels were controlled by pressure of the fingers, and the kidney cortex was split over the mass. This mass was found to consist of a rounded, firm tumor about the size of an ovary; it was easily shelled out. The rents in the pelvis and kidney were closed.

Dr. J. H. Wright reports that the diagnosis is hypernephroma. This patient died a few months after the operation.

CASE V.—L. C., woman, forty years old, married; July, 1904. M. G. H. records, vol. 480, p. 97. The family history is negative. The patient's history: cholecystotomy for gall-stones eight years ago. No catamenial period for one year. Three children living. Has lost about sixty pounds in weight during the past two years. She has pain in the lower part of the abdomen, a bearing-down sensation and no appetite. The bowels are regular and she sleeps fairly well. Nothing abnormal in heart or lungs. Abdomen prominent and tense from distention. An umbilical incarcerated omental hernia size of a walnut is evident. Abdominal asymmetrically distended to left of median line, not tender. Exploratory laparotomy by Dr. C. L. Scudder. Much thickening of the anterior parietal peritoneum. Encysted peritonitis toward the pelvis. Upon the peritoneum of the intestine were numerous white opaque spots the size of a pin-

head, slightly raised above the surface. On the side of each ovary was a mass, two inches in diameter, papillomatous in appearance, hard and white. Small section of mass on left taken for examination. Nothing abnormal was felt in the liver. It seemed probable that the ovarian masses and the disseminated spots upon the peritoneum were malignant, therefore no further operation was deemed wise.

She died March 4, 1905.

Pathological Report.—Two small irregular masses of tissue from the abdominal cavity. One was of irregular shape, 2x4 cm. in diameter, and consisted of soft, friable translucent tissue. The other piece was firmer and of opaque, grayish white color, 1x2 cm. in diameter.

Microscopic examination showed nests of cells having in some places a glandular arrangement and in other places being arranged in columns separated by a small amount of fibrous tissue. The cells were large, with rounded nuclei and considerable protoplasm which, in some, showed fatty degeneration. In some places the cells were in large masses and showed a smaller amount of protoplasm. These larger masses were separated by cellular myomatous tissue. Hypernephroma.

(Signed) W. F. WHITNEY, M.D.

CASE VI.—S. P. H., a woman, fifty-eight years old, unmarried. M. G. H. records, vol. 479, p. 71. August, 1904. Family history negative. Patient's history: measles, chicken-pox, scarlet-fever at three years, after which was somewhat deaf. Climacteric five years ago. Some indigestion; always constipated; drinks considerable tea. Fifteen months ago weighed 198 pounds, now weighs 138 pounds and has lost fifteen pounds in the last six months. Six weeks ago had pain in the right side and noticed a bunch about the size of a hen's egg. "Felt bad," no appetite, nausea and slight vomiting. The lump has grown steadily. The heart has a systolic murmur, heard loudest at the base, not transmitted; the lungs are normal. The abdomen is large and flabby. On the right side, just opposite the level of the umbilicus, was a rounded tumor, with several lobes, about the size of a large grape-fruit. It extends from the region of the right kidney to the anterior abdominal wall, with a space separating it from the liver and considerable space between it and the pelvis. It extends to

the median line. On inflation of the colon the tumor lies to the right, towards the diaphragm. The tumor moves freely with respiration.

A nephrectomy by Dr. S. J. Mixter. Recovery. Confined to bed with malignant disease of abdominal organs, dying November 4, 1905.

Pathological Report.—The specimen consisted of a rounded growth from the kidney 14 cm. in diameter, from the surface of which considerable fat was removed. On section the growth consisted of a cavity 10 cm. in diameter, filled with thick yellow pus. The cavity contained a flattened stone 1 cm. in diameter and a rounded mass of tissue 3 cm. in diameter covered with fibrin. The rest of the mass was composed of a soft tumor of translucent, red, grayish color, 5x7 cm. in diameter. Scattered throughout this were many bright yellowish areas. The growth was divided into cross lobules by bands of fibrous tissue extending down from the capsule.

Microscopical examination showed soft masses of large endothelial-like cells often arranged in columns. Nuclei were round and vascular, and a large amount of cytoplasm, and most cells showed fatty degeneration. In places the tumor was very vascular and in others extensively necrotic, these latter areas being infiltrated with large numbers of leucocytes and round cells.

Diagnosis, hypernephroma.

(Signed) W. F. WHITNEY, M.D.

CASE VII.—J. H., a man, thirty-seven years old, single. M. G. H. records, vol. 490, p. 25. October, 1904. Last June he stopped work because of soreness and pain in the right loin upon moving at his work. This condition came on in a week and has persisted since. No blood detected in the urine. Three years ago he had typhoid fever. Heavily alcoholic up to four years ago. Nothing abnormal found in either heart or lungs. No rigidity of abdomen and no tenderness. In the right loin there is a soft mass. The kidney is palpated with ease. Bimanually, it can be slid up under the cartilage of the ribs, and can be displaced almost to the iliac fossa when the patient is lying on his side.

Operation by Dr. J. C. Warren. Nephrectomy. Died in August, 1905, of "liver complaint."

Pathological Report.—A lobulated new growth, 6 cm. in

diameter, situated on section of kidney. On section, of a variegated yellow, red appearance, somewhat lobulated in structure and soft in quality. The large veins in the pelvis were filled with a similar new growth, as was also some veins in the lower part of the kidney. The rest of the kidney-structure was normal in character.

Microscopical examination showed a structure composed of large cells with rather clear protoplasm, and its end edges separated into a rather lobular arrangement of thin glands of connective tissue and small thin-walled vessels. Hypernephroma.

(Signed) W. F. WHITNEY, M.D.

CASE VIII.—J. H., seventy-five years old. November 1, 1904. Hospital number, 139,906. Autopsy, No. 1270. He has had a bad cough for years, and pains for six months in the left eye and frontal region. He has lost weight. He fell on the kitchen floor and fractured his thigh, and was then brought to the hospital. The patient is an emaciated old man, having arteriosclerosis. The left eye-ball is protuberant. A firm, hard, tender mass is attached to the roof of the left orbit. Many nodules are scattered over the body, the size of a chestnut to a large walnut. There is one ulcerating mass over the sternocleidomastoid muscle and one over the right scapula. The nodules are firm, moving in the skin, not tender or red. No tumor is felt in the abdomen. The urine is normal. The left femur is fractured at its middle. The usual Buck's extension was applied. The patient died two days later.

Autopsy by Dr. J. H. Wright, November 5, 1904. Anatomical diagnosis: Hypernephroma of the right adrenal. Metastases in the retro-peritoneal tissue, intestines, liver, lungs, pleura, myocardium, brain, subcutaneous tissue in various regions, left orbit and *left femur*. Local pneumonia of the superior lobe of the right lung. Adenoma of the prostate. Chronic pleuritis of the right lung.

CASE IX.—E. F. H., a man, thirty-three years old. M. G. H. records No. 135,648. January, 1904. For six years he has noticed a pimple upon the pinna of the right ear. This has gradually increased in size. Three years ago it had reached the size of the end of a thumb. It was cauterized. It recurred and grew rapidly. It has never been painful. It bleeds from the surface upon slight trauma. The urine is normal. The abdominal examination finds

nothing abnormal. The right ear-lobe and cartilage are changed to a foul, sloughing, bleeding mass. There are enlarged glands in the neck upon the right side. Operation by Dr. F. B. Harrington. Removal of ear and dissection of the right side of the neck.

Pathological report by Dr. W. F. Whitney.—The microscopical examination of the mass removed showed a lobular growth of large round cells, with little intercellular substance between them here and there.

Diagnosis.—Large round-celled sarcoma (hypernephroma).

May, 1904, the man entered the service of Dr. M. H. Richardson. The urine showed sp. grav. 1025; a very slight trace of albumen; no sugar; rarely a cast, a few squamous and round cells; a few red blood corpuscles. The wounds of ear and neck had healed. The man had lost thirty pounds in three weeks past. He complained of great pain in the shoulder and because of it was unable to sleep. He died June 22, 1904.

A complete autopsy by Dr. J. H. Wright. Hypernephromata of the adrenals. Metastases in the intestines, stomach, great omentum, mesocolon, retroperitoneal tissue, pancreas, peritoneum, right groin, right shoulder joint (*upper end of the right humerus*), subcutaneous tissues of the trunk, and brain.

CASE X.—W. W., sixty-five years old, married. Mass. Gen. Hospital, No. 143,207. June 28, 1905. Patient has always been well. During the past four months he has lost forty-five pounds in weight. A few weeks ago he noticed a swelling in the left scrotum. Has had dyspepsia for several years, of a mild type. Has been getting more and more constipated. Has never passed blood in the stools. He presents a cachexia. The abdomen is moderately distended. The left hypochondrium is occupied by a bulging tumor, which is elastic, smooth, semi-fluctuating, about the size of a foot-ball. The liver is palpable just below the right costal margin. There is a large varicocele in the left scrotum. The colon overlies the tumor.

An operation was done for the removal of a portion of the abdominal tumor for diagnosis, July 1, by Dr. J. G. Mumford. Patient died July 12, 1905. There was no autopsy.

The pathological report by Dr. C. C. Simmons of the bit of tissue removed from the abdominal tumor is as follows:

The specimen consisted of an irregular dark-colored mass of

fibrous tissue 10x12 cm. in diameter. On section portions of the mass were of a grayish translucent color, while other places were necrotic or hæmorrhagic. Microscopical examination showed solid masses of large cells arranged roughly in columns and having sharply-marked outlines and clear protoplasm. The nuclei were large and many of them vesicular. There were large numbers of mitotic figures. In places there were spindle-shaped cells, many of which were also undergoing mitosis. Hypernephroma.

CANCER OF THE GALL-BLADDER AND DUCTS.

BY J. GARLAND SHERRILL, M.D.,

OF LOUISVILLE, KY.

THE attention of the writer was drawn more particularly to this subject by the occurrence of four proven and two suspected cases of primary carcinoma of the biliary ways, in 25 cases of gall-bladder disease, in his private practice during the past few years. This percentage of cases of malignancy was so large that it excited surprise. The literature in this country is quite limited, only a few articles having appeared in American journals, notably those of Musser and Mayo, while the foreign literature is very voluminous. It seems, therefore, that the attention of the profession should be directed to the subject so that these cases may receive earlier and perhaps more successful effort for their relief. The outlook for them is so gloomy that one turns to the study of this condition with reluctance and with little hope of any lasting or noteworthy results. That the subject is of sufficient importance to demand consideration is shown by the increasing frequency with which cases are being observed. McNeal¹ in 1836 mentions carcinoma of the ampulla of Vater, and cancer of the gall-bladder was considered by Durand-Fardel in 1840, yet it was not until the classic works of Zenker in 1889 and of Courvoisier in 1890 that the subject received the consideration it deserved. Zenker collected 48 cases, of which eight were taken from the pathologic institute of Erlangen from 1852 to 1889. As he says eight cases, distributed over such a long time, is certainly a small number, when we consider that six cases followed one another in Breslau during 1876-77. In the pathologic institute in Helsingfors six cases of cancer of the gall-bladder and ducts were found in 3,775 autopsies in thirty years from 1858-1888. On the other hand, Petersen of the surgical clinic of Heidelberg, found 34 cases of carcinoma among 168 operations for

diseases of the gall-bladder, a rather alarming percentage; larger even than my own. Gersuny states that carcinoma forms one-fifth of all cases of gall-bladder operations.

G. R. Slade² makes some interesting and surprising statements concerning the frequency with which carcinoma of the gall-bladder was found in cases of stone examined post mortem. In 2,180 consecutive necropsies, 33 were cases in which gall-stones were present in the gall-bladder or had been removed just prior to death. In 17 of these 33 cases, the stones were latent and were discovered only at autopsy. In 16 of the latent cases the wall of the gall-bladder was not thickened and its mucous membrane appeared perfectly healthy. In the remaining case, the wall of the bladder was thickened, shrunk, and closely moulded over three large stones, so that no cavity remained. Microscopical examination of this wall showed carcinoma. Of the remaining 16 cases, in which stones produced symptoms, in one the gall-bladder had been removed for cancer shortly before death; in three cases the condition was pronounced cancerous on the post-mortem table; in two of these the opinion was confirmed by the microscope, and in the third the macroscopic appearance plainly showed its malignant nature. In 12 cases the wall presented an appearance of chronic inflammatory thickening. In seven of these no microscopical examination was made, but in every one of the remaining five, histological examination showed carcinoma. Cancer was found in 30 per cent. of all (10 in 33); in 56 per cent. of all cases where stones had caused symptoms; and in 58.8 per cent. (10 in 17) of all cases in which at the autopsy the wall of the gall-bladder showed inflammatory thickening. Slade also says that these figures, though startling, probably understate the true proportion. It should be particularly noted that in this calculation the seven cases not submitted to examination by microscope have all been reckoned as non-cancerous, although to the naked eye they presented an appearance exactly similar to that of the five cases which were examined and proved cancerous. Since he began in such cases to examine the wall of the gall-bladder as a routine, he has in no instance

failed to find indubitable cancer, hence he does not hesitate to suggest that had all cases been examined the percentage would have been very much nearer 100 than 58. The statement of Miodowski is somewhat corroborative of the claim of Slade. He says the external appearances are somewhat misleading and were considered by the older writers as simple induration, but the microscope will reveal their true nature. Osler states that five per cent. of all gall-stone cases show cancer, while Mayo found forty cases in 1,000 operations for gall-stone disease, and Schroeder places the ratio at 14 per cent., while my own cases show in a limited series, 16 per cent. of primary cancers of the gall-bladder and ducts.

It occurs subsequent to cholelithiasis with sufficient frequency to call attention strongly to the relation between the two conditions, and to add another weighty reason, to the many already existing, for early operation in gall-stone disease. Moynihan takes issue with Slade's figures, and says that the evidence of statistics and his own experience do not coincide with those of Dr. Slade. He says: "It is clear, I think, that the earlier stages of gall-stone disease in which operation should be practiced, so that these grave complications are avoided, is very sparingly represented in this series." He has performed over 40 cholecystectomies, two of which were done for malignancy; in 18 there was gross thickening of the wall, and in only one of these specimens was malignant disease found after careful examination. So far as he knows, only two cases have been recorded in which cancer developed after cholecystostomy had been performed. This apparently simple statement of Moynihan is worthy of consideration because of the contrast between the frequency of carcinoma of the gall-bladder in cases of cholelithiasis and its infrequency following cholecystostomy for stone. Studied in the light of Slade's statistics this statement seems to show that operation in the early stage of inflammatory thickening, or early cancer formation, may prevent the development of the clinical picture of malignancy.

The causation of carcinoma of the gall-bladder, while no

clearer than that of cancer in other parts of the body, is of especial interest, since it affords an opportunity to study the effects of heredity and of irritation, two conditions well recognized as playing an important part in the development of carcinoma. Some of the English writers claim that heredity can be traced in from 11 per cent. to 17 per cent. of cases. On the other hand, Schueppel denies that it plays any part in the causation. Its exact role cannot as yet be fully determined. The relation between stones and carcinoma of the gall-bladder is so close that we are forced to conclude that the irritation which they produce must be an important factor in the production of malignancy. Budd in 1845 called attention to the frequency with which cholelithiasis and cancer of the biliary passages were associated. He, with Frerichs and others of the older writers, considered that the carcinomatous growths in the walls of the ducts caused an obstruction to the outflow of bile and thus determined the formation of stones. The facts and the weight of opinion seem to show that while carcinoma may precede the formation of stones in a few instances, especially of duct cancer, yet in the vast majority of cases the cholelithiasis precedes and in many cases is an important factor in the development of carcinoma. What part is played by infection or living organisms, in addition to that of exciting inflammation and stone formation, yet remains for solution. The acknowledgment of the importance of irritation and inflammation does not deny the possibility of a living virus being the actual determining cause. The following reasons have been advanced to support the contention that the cholelithiasis precedes the malignancy in most cases: First, the frequency with which antecedent symptoms of cholelithiasis are present; second, as pointed out by Marchand, cancer is frequently present with calculi, without any evidence of obstruction to the flow of bile; third, cancer of the gall-bladder is more often accompanied by stones than is carcinoma of the ducts, while obstruction to the flow is more often found in the latter; fourth, the neoplasm frequently has its origin in the ulcers and cicatrices in the wall of the gall-bladder and ducts,

resulting from the prolonged irritation (pressure) of stones (Kelynack records two cases where stones were present in the gall-bladder although the cystic duct was occluded and the gall-bladder contained no bile. In one the stones were embedded in the tumor mass, in the other the stone lay in a depression just below a soft nodule of what was apparently the primary growth.) ; fifth, the frequency with which stones are found in cases of gall-bladder cancer, or in their absence, the frequency with which evidences can be discovered of their former presence; sixth, the frequency of their presence in primary cancer (95 per cent.) and their infrequency in secondary cases (15 to 16 per cent. Siegert) ; seventh, the large preponderance of primary cancer of these organs in women, greater even than the frequency of cholelithiasis in that sex and more than the relative frequency of cancer in men and women. Naunyn believes that half the cases diagnosed as cholelithiasis associated with chronic jaundice are either complicated with cancer or are due to this disease. The frequency with which stone is present in primary carcinoma is given by

Courvoisier as.....	74 in 84 cases	Jayle	23 in 30 cases
Musser	69 in 100 "	Siegert	94 in 97 "
Bodowski	40 in 40 "	Frerichs	9 in 11 "
Tiedeman	59 in 74 "	Richter	4 in 5 "
Zenker	41 in 48 "		

The average age of patients with cancer of the gall-bladder is 54.5 years, and in cancer of the ducts about the same or perhaps a fraction older.

Men and women suffer from secondary cancer of the gall-bladder with about equal frequency, while primary cases show a much greater frequency in women, who are affected four or five times as often as men. Zenker found 72.9 per cent. in women, while Naunyn found 83 per cent. in women and 17 per cent. in men. Miodowski found that in 41 cases of choledochus cancer, 26 were males and 14 females; one case gave no statement of the sex. Schultze reports 18 cases of primary disease of the hepatic duct of which twelve were males,

five were females, and one not stated. These figures show an almost reverse ratio to the frequency of primary gall-bladder cancer. Miodowski gives the ages of the cases of primary duct cancer as follows, in 39 cases: From 30-40 years, 3; 40-50 years, 8; 50-60 years, 9; 60-70 years, 14; over 70 years, 5. The growth may assume the type of a columnar-celled carcinoma, a spheroidal-celled carcinoma, an adeno-carcinoma, a colloid cancer, or as claimed by some a squamous-celled epithelioma, although some deny the existence of the latter. A number of cases of epithelioma of the bile-ducts have been recorded. Treutlein³ gives a tabulation of 108 cases of cancer of the gall-bladder reported by 29 authors, and classifies the cases clinically as scirrhus 78, as medullary 21, and as colloid nine cases. Stones were present in 99 of the cases.

The first evidence of primary carcinoma of the gall-bladder is to be found as a change in the structure of the wall. These changes are to be observed earliest in the mucous membrane and there consist of an abrasion or a loss of the epithelium in certain portions, with the formation of cicatrices as the result of inflammatory change, or the pressure of a stone or the ulceration following such pressure. Where there is no loss of epithelium, this layer may be transformed into layers of flat cells. As a result of the infiltration incidental to inflammation of the wall, and of cholelithiasis, a considerable number of the glands of the mucosa undergo atrophy. Again, as stated in Nothnagel,⁴ these glands may enlarge by sending out processes, and in this manner probably compensate the loss of the destroyed glands. Or some of the glands may be displaced by the connective tissue and this, in accordance with the theory of Ribbert, may determine the development of malignancy. These cells proliferate rapidly, fill the alveoli, and invade beyond the connective-tissue limits normally present. They may undergo a mucoïd or gelatinous degeneration largely as the result of imperfect nutrition, and assume the type of a gelatinous carcinoma. This form of growth is to be classified as an adeno-carcinoma. These changes may involve only a limited portion of the mucous membrane or they may be found

in every part of the organ. In some cases the entire cavity of the gall-bladder, except that occupied by the stone, may be filled with this new malignant glandular tissue; such a condition was present in one of my cases. The neoplasm may produce a marked increase in the size of the gall-bladder, or again it may be accompanied by a large amount of connective-tissue formation which causes it to become shrunken, sacculated, and to fit snugly about the stone. The connective tissue of the wall shows a marked increase, probably as a result of the infiltration consequent to inflammation. The muscular tissue is hypertrophied, and finally much of it is obliterated from the contraction of the new connective tissue. When the connective tissue develops more rapidly than the epithelial elements, the neoplasm assumes the type of scirrhus. It is claimed that in some instances the epithelial cells undergo a metamorphosis into flat cells and an epithelioma results.

In the early stages, a gall-bladder, the seat of carcinoma resembles very closely macroscopically one that has been the site of a chronic inflammation. In many cases it is small, shrunken, and sacculated, while in others it is enormously increased in size. In still other instances, the exterior may give little or no evidence of a malignant growth, such condition only being discovered after incision of its wall. The growth in such cases is of small size and usually situated at the site of a cicatrix, where a gall-stone rests or has rested. The possibility of the development of a carcinoma after the escape of a stone into the intestine or after its removal by cholecystostomy must not be overlooked, although such a result is quite infrequent. The growth may spring from any portion of the wall of the bladder, may involve its entire extent, or may be situated in the cystic, hepatic, or common duct. It may be annular in form, separating one portion of the gall-bladder from the other, and each of these cavities may contain one or more stones. Sometimes each stone is found lying in a separate compartment, new tissue having occluded the cavity in many places. These changes in the structure of the wall are of necessity slow in their development, the stones often having pro-

duced symptoms through a period of years. The wall of the bladder is able in many cases to resist the encroachment of a new growth for a considerable time, thus protecting the adjacent structures from early involvement, but sooner or later the growth extends through the wall and attacks the neighboring organs. The liver is one of the first organs to be invaded secondarily. The omentum, the stomach, the intestine, and the pancreas are all liable to attack. The latter organ may escape attack, in many cases, because the obstruction in the ducts results fatally before the neoplasm has extended to it. The growth shows a marked tendency to spread along the ducts, to invade their walls, and finally to reach the liver, the duodenum, and the pancreas by continuity. The lymphatic glands in the lesser omentum may be involved, but less frequently than is usual in carcinoma. Around a gall-bladder that is the seat of such a growth we are likely to find adhesions from inflammatory change, as is noted in so many cases of chronic cholelithiasis, yet in many cases the wall is smooth and free from adhesions. The latter condition is the rule in duct cancer. As the growth progresses it may show a number of nodules in the wall and liver as well.

In the early stages the gall-bladder contains bile and usually stones: as the cystic duct is narrowed the amount of bile is lessened and finally only a bile-stained mucus may remain. In other instances the cavity may be so completely filled that no space remains for fluid. When no fluid is present the glands of the wall will be found to be almost entirely obliterated. When the growth progresses to the point of obstruction of the common or hepatic duct the tissues are promptly stained with bile coloring matter, the blood loses its power of coagulation, the ducts become dilated, sometimes to an enormous extent, and numerous gall-stones may be found in the smaller ducts of the liver. When the obstruction lies above the entrance of the cystic duct the gall-bladder is small, but when the choledochus is occluded the gall-bladder is enlarged. This is an important point in determining upon the practicability of any operative procedure, as little can be hoped when the hepatics

are occluded. The kidneys very early show the pernicious effects of the toxic materials which reach them in the process of elimination. The blood, the heart, the spleen, and the general musculature of the body show marked degenerative change. Patients who have complete jaundice rarely live a year.

As a result of contractions about the portal system late in the disease, ascitic accumulation takes place into the abdomen.

Symptoms.—The careful investigation of the history of these patients will usually elicit some of the symptoms of cholelithiasis, although in some cases the first evidence of trouble is the appearance of a tumor in the right hypochondrium, or the occurrence of jaundice. The latter symptom may have been noted previously in mild degree, disappearing promptly, but when it occurs as the result of obstruction of the common or hepatic ducts it is persistent, yet may vary, now light, now dark. The temporary attacks just mentioned are often accompanied by fever, pain and vomiting, and are the result of a mild cholangitis. When such a patient loses flesh steadily and persistently, the suspicion of malignancy is strong. In the absence of jaundice, the skin presents a peculiar sallow, anæmic appearance, which is somewhat characteristic. The appetite may be fair in the absence of jaundice, but as a rule the digestion is impaired. The temperature is often subnormal, although intercurrent attacks of inflammation will cause a temporary elevation. One of my cases showed many attacks in which there was a high range of temperature and considerable evidence of sepsis. A small nodular or a large smooth growth may be felt in the region of the gall-bladder, which may or may not be tender on pressure. Usually tenderness can be elicited on deep pressure, but it is less than is present after an attack of colic or an attack of acute cholecystitis. In duct cancer no tumor is to be detected unless the gall-bladder is distended, when it presents as a palpable tumor. If the hepatic ducts are occluded, the gall-bladder is small and cannot be felt. When the ducts are encroached upon, the patient becomes icteric, and this jaundice while varying from

time to time rarely disappears entirely. At this time the stools will be found to be pasty and clay-colored. Ascites is not infrequently present late in the course of the disease, but none of my cases presented this symptom. The presence of ascites renders the prognosis especially grave. In many cases the right extremity of the liver is drawn downwards by the weight of a very large tumor of the gall-bladder; in two of my cases it extended almost to the iliac spine. With increasing jaundice, the patient develops a tendency to hæmorrhage which is very noticeable, and which is of the greatest importance in forming an opinion of the probable outcome of an operation, since the hæmorrhage may prove alarming or even fatal. The cholæmia becomes more and more profound and the patient finally succumbs to the poison. The symptoms of duct carcinoma, as a rule, to which, however, there are exceptions, are not preceded by a history of gall-stone colic or cholecystitis. In these cases the first symptom is jaundice, which may appear without any pain or tenderness. Later a tumor may be detected in the right hypochondrium, pear-shaped, with the lower margin free, continuous with the liver above, and moving with the diaphragm in respiration. The gall-bladder may be so distended that rupture may occur, as in a case reported by B. Huguenin.⁵ The occurrence of rupture is promptly followed by acute general peritonitis and the patient dies shortly of profound sepsis. Care should be observed in the examination of these over-distended bladders lest the manipulation cause rupture.

The diagnosis is to be made by a careful consideration of the antecedent history of carcinoma in the family, and of the patient having suffered from the symptoms usual to the presence of gall-stones for a prolonged period followed by a rapid loss of weight and strength. The pallor, the jaundice, and the presence of an indurated nodular mass in this region, whether accompanied by pain or not, are strong presumptive evidence of biliary cancer. The absence of jaundice, or even of a tumor, is not an indication that carcinoma is not present. Cancer of the ducts is to be suspected when jaundice is persistent and

progressive in an elderly patient who is losing flesh rapidly. The malignant growth of the ducts is usually of small size and cannot be detected, but the distended gall-bladder is often quite perceptible. To differentiate from stone in the common duct the gradual onset of jaundice is important, as most cases of common-duct stone develop jaundice very suddenly. One would think that the jaundice following the presence of a malignant tumor of the bile-duct would be constant and steadily increasing, while really many of such cases show a marked variation in the amount of jaundice, the patient being at times markedly clearer than at others. The jaundice from stone is subject to more abrupt change but may at times be as deep as that from cancer. Temperature is not a reliable guide in diagnosis between the two conditions, but the frequent occurrence of attacks of cholecystitis and cholangitis with a sharp rise of temperature would tend to strengthen the presumption of stone. The presence of great nodulation in a tumor in this region will justify a diagnosis of malignancy. The other conditions which may confuse the observer are: tumors of the stomach, intestine, or pancreas; tumors and hydatids of the liver; hydrops of the gall-bladder from mechanical cause; and tumors of the kidney. Tumors of the stomach will almost always present a history of indigestion, nausea, vomiting, hæmatemesis, pain increased by eating, and the presence of occult blood in the stools, also the absence of jaundice. Such symptoms should be sufficient, if taken in connection with an analysis of the gastric contents and motility, to allow one to reach a conclusion. Intestinal tumors will present symptoms of obstruction, or at least of intermitting diarrhœa and constipation, with the presence of a tumor which is more movable and which does not follow the diaphragm in its excursions. It may not be possible to differentiate between tumors of the pancreas and the bile-passages, although the presence of undigested fat in the feces may prove a valuable guide. Tumors of the liver are in the larger number of cases malignant and due to extension from the gall-bladder, hence the diagnosis is unimportant except as a matter of prognosis or to determine for or

against operative interference. The size of the liver and the amount of nodulation it presents will usually make the diagnosis clear, and as a rule when the growth has progressed to the extent that the surface of the liver presents palpable nodules, the case has passed beyond the aid of surgery. In hydatids of the liver the size of the organ will be greatly increased and fluctuation will usually be readily detected. Abscess of the liver will show a marked enlargement of the organ in a symmetrical way and will be accompanied by a low range of fever. Fluctuation will finally be noted, as will a certain amount of oedema over the abscess, and aspiration will make the diagnosis conclusive. Hydrops of the gall-bladder from mechanical causes will not show the marked emaciation that is present in malignant cases, and the condition which mechanically obstructs the duct will present its characteristic symptoms. Renal tumors can be differentiated by their position and by the symptoms being all referred to the urinary system, and also by a thorough examination of the urine. It is well to remember that gall-bladder growths keep well to the right side of the abdomen as they develop, and they do not always, in my experience, grow toward the umbilicus, as claimed by Musser.

The prognosis is of necessity very grave, a fatal termination being certain unless complete extirpation is done. The very nature of the condition and the structures in close relation which are so likely to be involved renders a cure even in this way very uncertain. Courvoisier recites a case of Hoche-negg which had gone for eight months without a recurrence, and says it is a highly satisfactory result. Woerner mentions one in good health three years after operation. With earlier diagnosis and a wide excision of the gall-bladder and the liver-tissue it would appear probable that the prognosis would be materially improved. In cases of cancer of the duct the mortality is of necessity higher, owing to the mechanical difficulty of removing the disease and reëstablishing the communication with the intestine. When the gall-bladder is healthy and contains bile a temporary respite may be given to the patient with duct cancer by cholecystenterostomy.

The treatment may be classed as prophylactic, palliative, and radical. The first, upon which too much stress cannot be laid, consists in the recognition of the importance of early operation for gall-bladder disease and the necessity of impressing this fact upon such patients. Formerly the writer held to the belief that many cases of gall-stones should be allowed to go without operation, if the symptoms produced but little disturbance. In the light of our present knowledge, we consider that every case of this condition, in which a diagnosis can be made, should be subjected to operation if the patient's condition will safely permit. Under prophylaxis may also be included measures to prevent cholecystitis and cholelithiasis, as it appears conclusive that these conditions are largely responsible for malignant disease of the gall-bladder. Palliative treatment is to be instituted in those cases which have passed beyond the possibility of radical attack, and will consist of measures designed to give the patients as much comfort as possible, while waiting for the end. The radical treatment includes any of the surgical measures instituted for the removal of the disease or for the temporary relief of the cholæmia. The most recent investigations show that a considerable portion of the liver can be safely excised, with the technic now in use. In order to insure the least probability of a recurrence, the liver-tissue about the gall-bladder should be removed, and if the liver presents to the eye evidence of malignancy it should be more freely attacked by the surgeon. If such free attack does not appear feasible, the operation should be abandoned. The chief danger, in such procedure, lies in the difficulty of controlling hæmorrhage from the liver wound. A number of plans have been advised to overcome this danger. The elastic ligature has proven quite serviceable for the temporary arrest of hæmorrhage, and has even been advised as a permanent means of hæmostasis, the stump of the liver being left in the wound. The fixation of the stump in the abdominal wall has the disadvantage of a greater risk of sepsis, hence it is not much employed. Dr. Leonard Freeman⁶ of Denver has published an article in which he mentions eleven methods of permanent

hæmostasis employed by different writers. The best of these consists of sutures applied in a special manner, and the use of gauze compresses. Kurzenow and Pensky in 1886 proposed a method which, as modified by Auvray in 1897, consists of the passage of a double thread from side to side through the liver, cutting the outside loops of thread and by multiple ligation controlling the flow of blood. These ligatures may cut through the friable parenchyma but hold the blood-vessels. To prevent the ligatures cutting through the liver-tissue nothing will prove so satisfactory as a small roll of gauze over which the ligatures are passed; after the catgut is absorbed the gauze can be readily removed by slight traction upon an end which has been left in the wound. Hochenegg has already made use of gauze as a compress sutured in the liver wound, but did not make use of it in the way just mentioned. Whatever method of control may be employed, it will be found wise to place a pack of gauze over the wound in the liver to control capillary oozing. Such a pack will usually be needed in cholecystectomy for cancer to provide for drainage of the ducts.

The mortality of operations upon cases of cancer of the gall-bladder will of necessity be high,—first, because of the condition in which these patients are found when they come to the surgeon for relief; being usually anæmic, low in flesh and strength, with all the organs impaired, and very poor surgical risks. They may be suffering from jaundice of a persistent type, making the control of hæmorrhage a most serious problem. The presence of jaundice adds so much to the risks that Mayo says it contraindicates operation. Again, these patients have usually suffered for some years from the effects of gall-stone disease, hence have acquired many and dense adhesions in the region of the gall-bladder, which will add to the mechanical difficulties of the operation, thus prolonging it when everything demands that it should be completed with celerity. The hope of a permanent cure must be small when all things are considered. The primary mortality will depend largely upon the time at which these patients come for operation, and upon

the surgery necessary for their relief. Mayo reports nine deaths in forty operations for malignant disease of the gall-bladder, or 22.5 per cent. Hans Kehr records a case of recovery from hepatico-duodenostomy for duct cancer. Heimann gives a table showing 169 cases collected in years of 1895 and 1896 from reports of the Royal Statistical Bureau of Prussia: 147 treated, 95 died, 64.6 per cent. mortality; 42 operated, 24 died, 57 per cent. mortality.

The methods of removal of the growth and the plastic surgery necessary in these cases must be determined by the conditions met, and this field of surgery is certainly not suited to the timid operator.

From a consideration of the facts set forth in this paper it seems that failure to urge an early operation to patients suffering from disease of the gall-bladder is reprehensible, even if no other reason existed than the remote one of the late development of malignancy, while in fact there are many reasons which urge early interference which the scope of this paper does not permit us to discuss. One of the most difficult problems which arises in connection with this subject is to determine which case offers a chance for benefit to the patient by operation and which does not. Three conditions seem to us to be rather strong contraindications to interference, viz., the presence of marked jaundice, the presence of a palpable nodulation in the gall-bladder region, and ascites. As a rule either of these conditions shows that the disease has progressed beyond the aid of the surgeon. Again operation is not to be undertaken in cases which show marked defect in the urinary secretion or in the action of the cardiac and respiratory organs.

We have had opportunity to see four cases of carcinoma of the gall-bladder and ducts which have come to operation, in addition to two cases in which the operation was abandoned after the abdomen was opened, and which were not positively demonstrated as primary disease of the gall-bladder although there is every reason to believe that such was the case. Both of the latter cases had marked jaundice; in one a tumor could be felt and in the other the mass lay too deeply under the liver

to allow detection by palpation. One of these patients lived for three months and the other is still alive, but the time is too short since the operation upon the last patient for the case to be of any value. Of the four primary cases two were primary of the gall-bladder and two of the ductus communis. One of the latter presented evidences of malignancy in the wall of the gall-bladder as well as in the duct, but the history clearly shows that the duct was first involved. The cases of duct cancer occurred in a colored man of sixty and a white woman of fifty-four years. The patients suffering from cancer of the gall-bladder were white, one a male of fifty-eight, the other a female of fifty-three years. Stones were present in all except that of the colored man with duct carcinoma.

CASE I. A colored man of about sixty who gave an unsatisfactory history. He was markedly jaundiced, had lost considerable flesh, his appetite was poor and the cholæmia was pronounced. A diagnosis of gall-stones was not substantiated by operation, the condition consisting of a duct cancer with a distended bladder and a small cyst of the pancreas near its tail. A cholecystenterostomy was performed, which resulted fatally as the result of an error in technique, the latter consisting in the use of a second or reënforcement suture for the Murphy button. The wall of the gall-bladder was thin and unable to stand the strain of the tension produced by this additional suture. Murphy has later advised against the use of such a suture. The specimen of growth obtained post mortem showed it to be a carcinoma of the glandular type involving the lower end of the common duct.

CASE II.—Cancer of the duct and gall-bladder. This patient was a white woman of fifty-four, whom I first saw June 17, 1903. Her father died of jaundice, probably malignant, at the age of sixty-two, one aunt died of cancer of the uterus, and one sister died in January, 1903, at the age of fifty-six, of cancer of the liver, in the same room in which I found this patient. She had washed her sister's clothes after her death, but did not wait upon her much while sick. Her sister had vomited occasionally and the room had not been thoroughly cleaned or disinfected. Her personal health had been good except for constipation until De-

ember, 1902, when she began to feel sick with pain in the right side of the abdomen, lasting two or three days. Five weeks before I saw her she had a chill, but soon improved. One week later she became nauseated, vomited, lost appetite, and became jaundiced. Soon after this a mass was felt in the right side of the abdomen. Since the appearance of this mass she has suffered very little pain, but has lost about fifteen pounds of flesh, and the jaundice has deepened. She feels fairly well with the exception of extreme weakness. On examination a smooth, firm, pear-shaped mass is found in the upper right abdomen. It is connected with the liver above and extends down along the outer edge of the rectus to within an inch of the anterior superior spine of the ilium. A probable diagnosis of cancer of the gall-bladder was made, and after a full explanation of the dangers, an exploration was advised. The urine showed a large quantity of bile, albumin and casts. The hæmoglobin percentage was 70, the white cells numbered 9000 and the red 6,880,000.

Operation June 24, 1903. The gall-bladder was greatly distended, and contained a large quantity of yellowish bile mixed with mucus, and one large and several small stones. Careful exploration of the ducts showed no other stones, but at the duodenal end of the common duct a small, hard nodule the size of a hazelnut could be felt, which was at first thought to be a stone, but careful investigation disproved this. The gall-bladder was stitched to the peritoneum and fascia of the abdominal wall and drained through a rubber tube. The patient recovered from the operation nicely and while there was a slight improvement in the jaundice it never disappeared entirely, convincing us that the original diagnosis was correct. She died December 13, 1903, in a markedly cholæmic condition. The postmortem showed the gall-bladder, which was large at the operation, to have become small, contracted and functionless save for some mucous contents. The common and cystic ducts were completely obstructed, and the former and the hepatic ducts were widely dilated and filled with bile. The liver was nutmeg in appearance, bile-stained, larger than normal, and contained in its dilated ducts a number of stones. The same nodule which was felt at operation was found slightly enlarged at the duodenal end of the choledochus, and considerable thickening and induration existed at the junction of the cystic and hepatic ducts, in the adjacent liver, and in the wall of the

gall-bladder as well. Dr. John E. Hays reports the microscopical examination to show the condition to be an adenocarcinoma of the ducts and gall-bladder.

CASE III.—Carcinoma of the gall-bladder. This patient, a white man of fifty-eight, was seen about one year ago. He gave a history of repeated attacks of gall-stone colic, but had refused operation, and his physician had exhausted the usual remedies for the relief of the condition without avail. On one occasion the patient had passed several gall-stones in the stool. Recently he had lost about forty pounds and was having attacks of fever, chills, pain, and vomiting. I found him pale, flabby-cheeked, and looking very much aged. His pulse was 50 and very feeble. A hard nodular mass could be readily felt under the right rib margin, which was only slightly tender on pressure. He was slightly jaundiced, and his urine was not favorable for surgery. A diagnosis of gall-stones was made, with strong probability of cancer of the gall-bladder. A very gloomy prognosis was given and exploration suggested as the last resort. A month later, after consulting several other gentlemen, he requested me to make the exploration, and I reluctantly consented. He was then suffering from a marked toxæmia and was running a fever of 103. No encouragement for a recovery was given the family. The operation was done under ether, which was taken badly, and a small gall-bladder completely covered with adhesions and containing no bile was removed. Three small stones were found, one lying outside the wall, one in the wall, and one inside the bladder. The patient did not stand the operation well and died at the end of twenty-four hours.

CASE IV., a white woman of 54, gives a history of repeated attacks of gall-stone colic for the past six years, with an increasing tumor in the right hypochondrium during the past year. She has been jaundiced often, vomited and suffered pain, and during the past year has lost forty pounds. The mass was globular, cystic in feel, slightly movable, and extended from the ribs to the anterior iliac spine. It simulated a hydronephrotic tumor, as the colonic resonance was internal to it. The patient had a sallow, cachectic skin, but was not icteric. A diagnosis of distended gall-bladder, possibly malignant, with stones, was made. Operation December 12, 1905, revealed a very large gall-bladder, containing a large carcinomatous mass and over forty stones, which

was removed with a portion of the adjacent liver-tissue. The stump of the cystic duct was ligatured with catgut, contrary to the usual plan of treatment in these cases, as there seemed to be no necessity for drainage of the ducts. The liver was sutured with catgut and a gauze pack inserted to control oozing. She suffered from temporary suppression of urine and her condition was critical for two days following the operation, but from that time her improvement was continuous. The microscopical report shows these cases to be adenocarcinomata of the gall-bladder. The gall-bladder in the last case was almost completely filled with a soft, papilliform growth, leaving just enough room for the stones and a small amount of fluid, almost the entire wall of the gall-bladder being involved in the growth. Infiltration of the liver by the malignant tissue was shown at several points. The drawings show the gall-bladder intact and cut transversely.

Figure 1 represents a section taken from Case II, which was an adenocarcinoma of the common duct with the secondary, or coincident, involvement of the gall-bladder, which to the eye presented only the appearance of inflammatory change. Sections from this growth through the wall of the duct into the tumor proper show the wall to be invaded with adenomatous tissue. The mucous membrane of the duct itself is very little changed, but infiltrating the other coats we find a proliferation of poorly developed gland-tissue. The glands are irregular in shape and size, and are lined with a varying number of ill-formed columnar cells. The fibrous coat is thickened, and shows but little stroma between the glands. In some places the lumen of the glands is entirely filled with epithelial cells.

Figure 2.—Primary carcinoma of the gall-bladder. Case III.—This section includes the gall-bladder wall and a portion of the adjacent liver-tissue. The pathologic findings are described by Dr. John E. Hays as follows: "The liver lobules show fatty degeneration and passive congestion. The adventitious coat of the blood-vessels is very much thickened. An increase of new connective tissue in the portal canals, and an irregular distribution of the ducts, is observed. The growth in the gall-bladder is composed of an abundant stroma of connective tissue holding the new glandular structure. These glands are very much dilated, tortuous and lined with one to several layers of columnar epithelium, fairly well formed. This epithelium breaks



FIG. 1.—Case II.

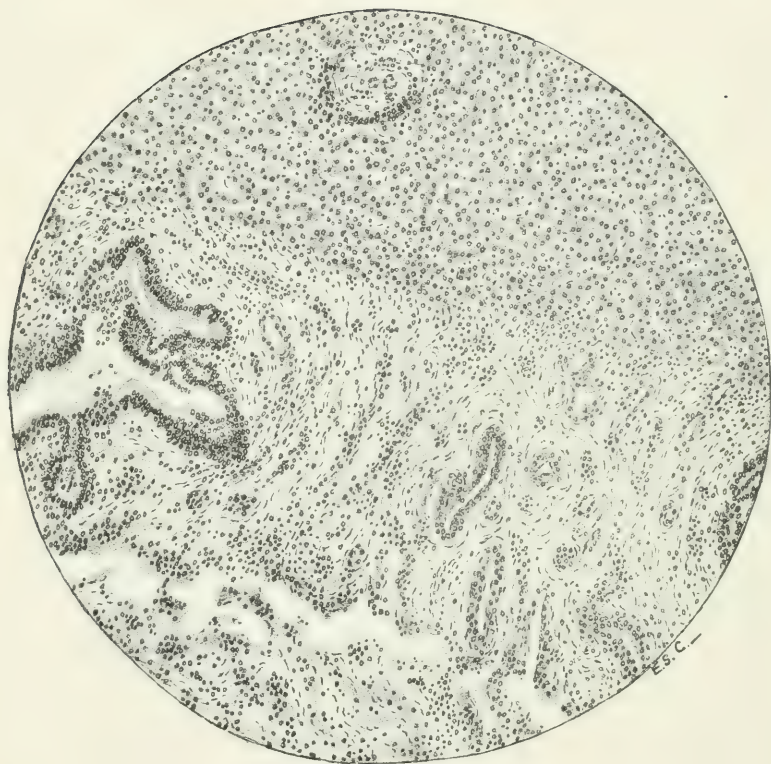


FIG. 2.—Case III.

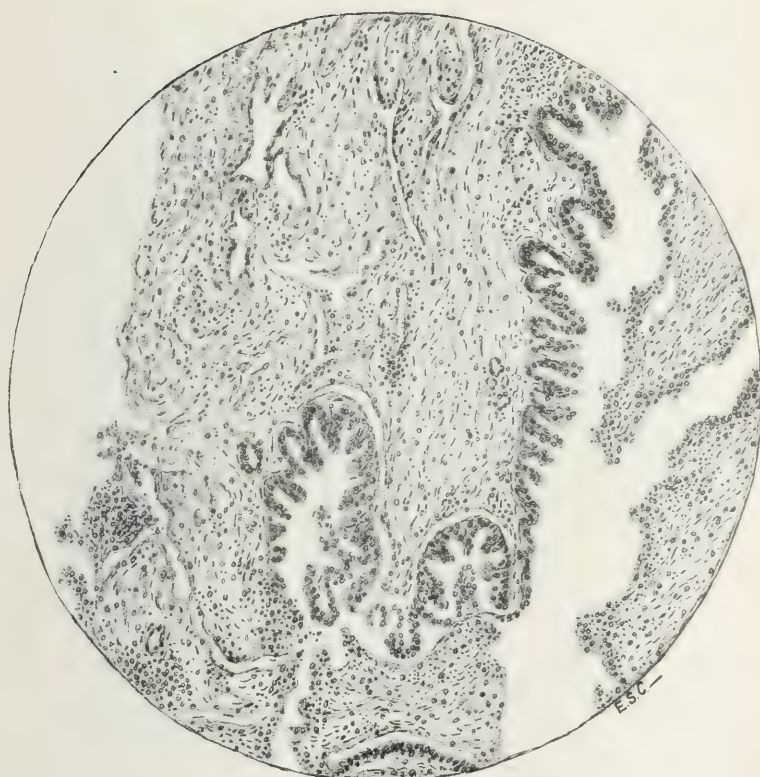


FIG. 3.—Case IV. Low power.

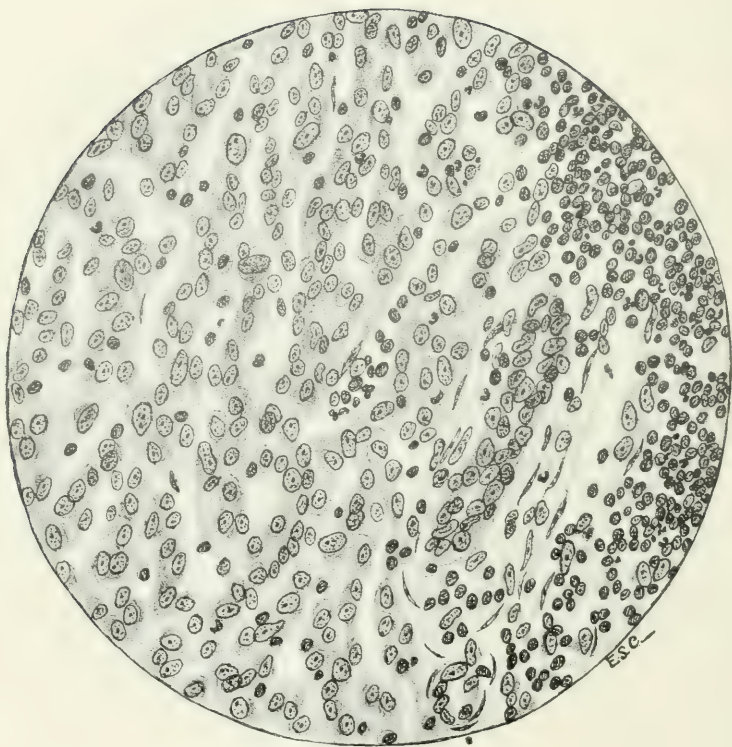


FIG. 4.—Case IV. High power.

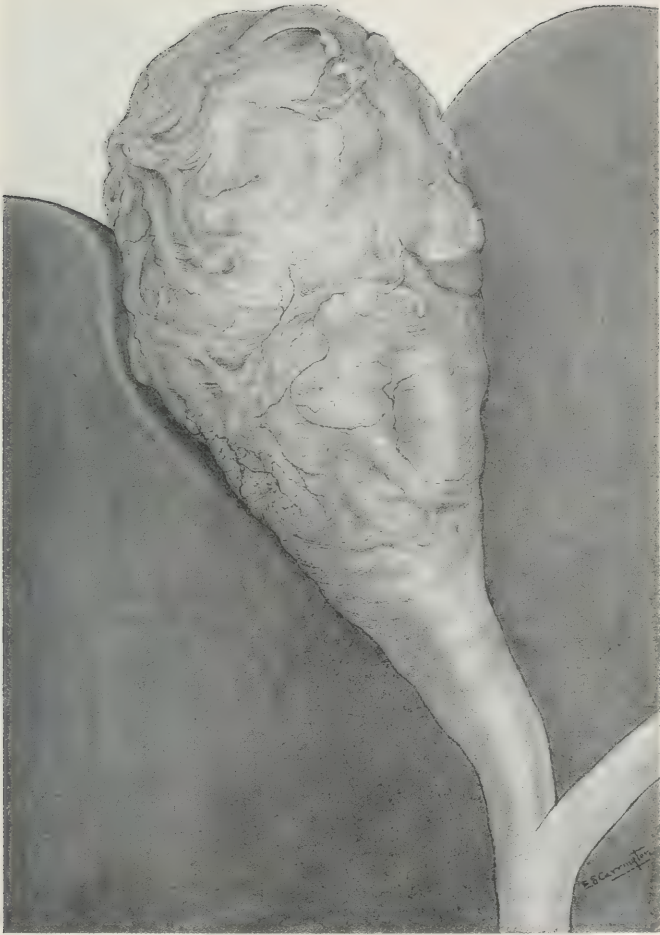


FIG. 5.—Gross appearance, Case IV.

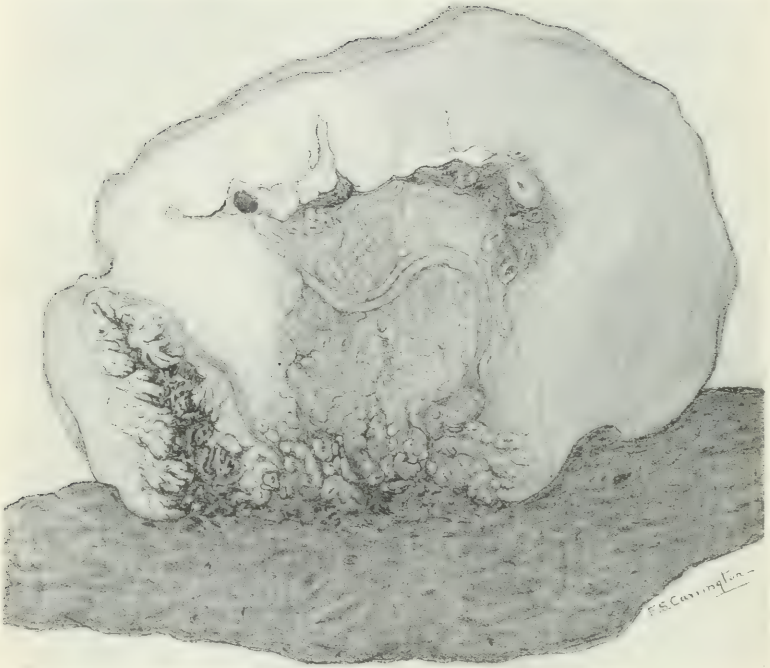


FIG. 6.—Transverse section illustrating Case IV.

through the basement membrane in places and infiltrates the surrounding stroma and liver-tissue. At one point in the section an accumulation of squamous cells is seen, and considerable round-cell infiltration of the connective tissue of the portal canals is noted."

Figures 3 and 4.—Adenocarcinoma of the gall-bladder, papilliform in type. Case IV. This section shows the neoplasm growing largely into the lumen of the gall-bladder, almost filling its cavity, and also a marked involvement of the wall of the gall-bladder throughout its entire thickness. The new growth consists of a proliferation of adenomatous tissue, papilliform in the arrangement of its glandular elements. The glands are very irregular in size and shape, and are covered with several layers of badly developed columnar epithelium, and a very small amount of stroma. The gland-tissue which invades the wall of the gall-bladder has the same structure as that within its lumen.

Figure 5.—Gross appearance of Case IV.

Figure 6.—Transverse section of same.

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TUMORS OF THE MESENTERY.¹

WITH REPORT OF A CASE OF FIBROMA.

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INNOCENT tumors of the mesentery might be said to be very rare, cysts being the most common. Of the solid tumors, lipomas seem to predominate, fibromas being the most rare. Benign tumors may occur in any portion of the peritoneum, but more especially in the omentum and mesentery. They may be either single or multiple. The omental tumors are usually not omental—that is, they usually originate in some other organ.

Lipomas in the subperitoneal tissues of the anterior abdominal wall have been repeatedly described. They usually protrude into the abdominal cavity, and vary greatly in size. They may also be present in the omentum and mesentery. They may grow to enormous size, so as to fill the entire abdominal cavity.

Fibromas of the peritoneum, the most rare, must be distinguished from so-called fibrous peritonitis, in which the peritoneum is uniformly covered with fibrous-tissue overgrowth. The larger fibromas may be as large as an adult's head or larger. Lexer removed a fibroma weighing five pounds from the mesentery of a man aged forty-five years, who had suffered with colic for several weeks.

It is possible for a fibroma to be detached from a broad ligament or uterus, and reattached in some mesenteric region, but this is probably rare.

Anderson quotes a remarkable case in which there were twenty-one fibromas, the largest weighing over seven pounds.

¹ Read before Mississippi Valley Medical Association, at Indianapolis. October, 1905.

Dr. Vance says mesenteric tumors were described as early as 1803 by Portal, and classified by him as scirrhus, stony, cancerous and hydatid. He describes the diagnostic features clinically and points out the difficulty of differentiating between mesenteric and omental tumors. His work was post-mortem. We hear nothing more of mesenteric tumors till 1880, when Tillaux reported a case of cyst of the mesentery successfully removed. In the same year Pean reported three such cases operated on by him, giving the diagnosis and treatment. In the next few years numerous cases of cysts were reported, but reports of solid tumors were exceedingly rare. So rare was this condition of solid tumors of the mesentery that Mr. Lockwood states that no such tumor had been exhibited to either the London Pathological or Medical Society prior to 1895. In 1897 Mr. Shield reported a case to the Medico-Chirurgical Society of London, at which time the subject was quite unfamiliar to that society. Douglas read a paper on this subject before the Southern Surgical and Gynæcological Society in 1898, and no surgeon present had had any operative experience with these tumors. Dr. Vance reports a tabulated comparison of solid tumors of the mesentery. Out of 27 cases there were nine of fibromata and two myxofibromata.

As to etiology we know nothing. Trauma is said to be a cause. Most of the tumors become rapidly malignant. The origin is generally between the folds of the mesentery, or else retroperitoneal.

The diagnosis is never certain and generally it is not known until the abdomen is opened.

Theoretically, we should expect two prominent diagnostic symptoms: intestinal obstruction, and resonance on percussion, but these symptoms are usually absent. One important symptom in this case, which I believe to be a common one in mesenteric tumors, was the free mobility.

I do not believe that it is possible, even if it is known that there is a tumor of the mesentery, to make out whether it is solid or cystic, as statistics show that most solid tumors of the

mesentery or omentum give the sensation of fluctuation, and I notice that two cases besides my own were aspirated during the operation with the expectation of finding fluid.

Treatment can only be surgical. The mortality certainly is high, but the probabilities are that if these cases were brought to operation early, before the pressure causes so many adhesions, the hæmorrhage and shock would be less and consequently the death-rate lower. In view of the rarity of fibromas of the mesentery I venture to report a recent case:

CASE HISTORY: Miss Grace ———, aged 15 years. She had noticed no change in health until November, 1904, when at this month she missed her menstrual period. Her mother noticed also that she complained of nausea, especially in the afternoon and evening. On consulting a doctor, he gave her some simple remedies, without much relief. She was working in a factory and had to give up her position. She gradually lost flesh, had nausea constantly in the afternoon, and in the following March she noticed an enlargement on the left side of the abdomen on a level with the umbilicus. This growth enlarged and when she again consulted her doctor, he advised her to go to the hospital, when two surgeons saw her in consultation and advised an operation. She was prepared for operation and placed on the table, and when under the anæsthetic the tumor disappeared. The doctors thought probably it might be a cyst which had ruptured. The anæsthetic was withdrawn, and when the patient became fully conscious the tumor reappeared. This was positive evidence that the tumor was still present and not ruptured.

I saw her some six weeks later, she having been referred to me by Dr. Haning. Upon examination I found the tumor lying on the left side, the lower border being on a level with the umbilicus, ovoid in shape, with its greatest diameter transverse to the abdomen. There seemed to be an indistinct fluctuation. The girl was emaciated, quite pale, and had not menstruated for seven months. Upon inquiry into her childhood period we found that she had had measles and mumps several years before, but had had no sick spell of any consequence in the last few years. She had been robust, apparently perfectly well, until the missing of the menstrual period in November. From this time on, as before

stated, she had constant nausea in the afternoon and evening, feeling perfectly well in the morning and at night. She had begun to menstruate between thirteenth and fourteenth years of age, and had menstruated regularly and normally until this time. She was troubled with constipation, had cramp-like pains in the left side, was slightly tender on pressure, and had a little gaseous distention, probably due to the obstruction by pressure in the abdomen. Urinalysis negative.

She was sent to the hospital and after due preparation was anæsthetized and, as in the first anæsthesia, the tumor disappeared. Knowing of its reappearance before, we made an exploratory incision and found the tumor in the lesser omental cavity. There were very firm adhesions to the middle of the posterior wall of the stomach, and it was attached by a short pedicle to the transverse mesocolon, from which it seemed to spring. There was fluctuation, as if it contained a semi-fluid, and being firmly attached, we punctured it, expecting to lessen its size, but found that it was a solid tumor. We then tied off its attachment to the stomach, and cut same, and rapidly peeled it out from its other attachment, except the mesenteric. This we ligated in two parts and severed. The hæmorrhage was very free, so much so that we could hardly find the bleeding vessels. As a consequence, we packed the wound with a large amount of gauze wrung out of hot salt-solution, and made strong pressure from above for five minutes, until the capillary hæmorrhage ceased.

We then cautiously pulled out the abdominal pads and picked up the bleeding arteries and ligated. Still having some oozing, we packed the cavity lightly with gauze and drew out the end from upper edge of the wound, leaving two stitches untied. After twelve hours we pulled out one-half of the gauze and at the end of twenty-four hours drew out the remainder, and tied the last stitches.

The shock was quite severe, and this, coupled with extreme hæmorrhage, necessitated our transfusing and stimulating the patient to the extreme. She made, however, an uninterrupted recovery, and has since gained fifteen pounds. She has menstruated twice since the operation, and her mother says that the menstruation appeared to be normal in every way.

Upon examination we found the tumor to be about four inches long, three inches wide and one and one-half inches thick.

It was very flabby, as though it contained fluid, and even after it was removed one of the assistants suggested that there must be fluid in the center of the tumor, but upon cutting it open we found it to be entirely solid. I think that this is a common histological feature of fibromas of the mesentery. In two similar cases recorded aspiration was attempted during operation. We submitted the specimen to the pathologist, Dr. D. B. Conklin, and by his courtesy we are able to submit the following report:

Specimen discoid in shape and flat antero-posteriorly. Size 10.5 cm. long, 9.25 cm. wide and 3.75 cm. thick. Surface smooth and apparently covered with peritoneum, with a pedicle on the posterior flat surface, with a lateral insertion. Tumor soft and elastic to the touch and resembling a soft uterine fibroma. Color dark red and mottled. Sections were taken from the superficial and deep portions of the tumor and stained with eosin and hæmatoxylin. Microscopically the sections were made up of flattened or spindle-shaped cells of fibrillar connective tissue, with very irregular arrangement of fibres and relatively small amount of intercellular substance. There were many blood-vessels to be seen and a considerable degree of cedema was present. Section taken from the periphery of the tumor showed it to be covered with peritoneum.

ABSTRACTS OF REPORTED CASES OF FIBROMA AND FIBROMYOMA OF THE MESENTERY REMOVED BY OPERATION.

No. 1. Pean. Sex and age.—Female, 40. Clinical symptoms.—Tumor reaching from epigastrium to pelvic cavity, dull on percussion, fluctuating at certain points. Diagnosis: Ovarian cyst. Operation.—Old, vascular, parietal adhesions. On puncture no fluid came away. Enucleation, ligature of a pedicle of connective tissue attached to lumbar spine and of another pedicle insertion on pelvic brim. Both pedicles fixed to lower angle of abdominal wound. Weight and nature of tumor.—Over 7.5 pounds. Pure fibroma, very soft. Result of operation.—Speedy recovery, no recurrence.

No. 2. Folet. Sex and age.—Female, 20. Clinical symptoms.—Abdominal swelling about one year; pregnancy, and later ovarian cyst suspected. Tumor size of man's head, resonance over portions of its left side. Operation.—Trifling parietal adhesions. On puncture no fluid came away. Layers of mesentery almost evenly opened up and strongly adherent to tumor. Damage to intestine, much resected, segment fixed to abdominal wound. Enucleation, but base adherent to aorta, and vena cava not removed. Weight and nature of tumor.—Weight not given. A very firm, uniformly white, fibrous tumor. Result of operation.—Death in twenty-four hours; the resection had proved a failure, turbid fluid in pelvis.

No. 3. Brookhouse. Sex and age.—Male, 56. Clinical symptoms.—Weak health two years, tumor noticed ten months, reached from epigas-

trium to pubes, and extended into flanks. Very hard, smooth, movable to a certain extent, painless. Operation.—Anterior layer of mesentery forming capsule to tumor divided. Enucleation (easy, little hæmorrhage). A flap of redundant capsule cut off. Parietal wound closed. Weight and nature of tumor.—13.25 pounds. Dense fibrous tissue, small cystic cavities. Result of operation.—Death in thirty-two hours, ascribed to shock.

No. 4. Müller (Aix-la-Chapelle). Sex and age.—Female, 33. Clinical symptoms.—Pains in abdomen several years; frequent diarrhœa. Tumor came down into pelvis. Diagnosis: Ovarian dermoid. Operation.—Tumor invested by both layers of mesentery corresponding to jejunum; 11 inches of adherent bowel resected; suspicious mesenteric glands removed, pedicle of connective tissue containing large vessels ligatured and divided; upper end of intestine implanted into lower end, the extremity of which was fixed to lower angle of wound. Weight and nature of tumor.—Weight not given. A large, fibrous mass, free from malignant elements. Result of operation.—Early sloughing of divided end of lower part of intestine. Nine months later the patient was free from recurrence.

No. 5. Folet. *Loc. cit.* Beguin. Sex and age.—Female, 10. Clinical symptoms.—A very movable hypogastric tumor of the size of two fists; no discomfort; discovered by accident. Operation.—Tumor invested by mesentery; easy enucleation, little hæmorrhage, capsule dropped and abdominal wound closed. Weight and nature of tumor.—Over 4 pounds 6 ounces. A pure fibroma. Result of operation.—Speedy recovery.

No. 6. Richelot. *Loc. cit.* Beguin. Sex and age.—Female, 16. Clinical symptoms.—Two years tumor in umbilical region; dull, as big as fetal head at term. Operation.—Omental adhesions; tumor covered by intestines, connected with its capsule; enucleation easy, tumor sloughy, fetid. Capsule fixed to parietes and drained. Weight and nature of tumor.—Three pounds. Fibroma, sloughing in center. Result of operation.—Death seventh day. Purulent peritonitis around sutures fixing capsule.

No. 7. Binand and Beguin. *Loc. cit.* Beguin. Sex and age.—Female, 50. Clinical symptoms.—One year tumor; hard, tuberos, movable; only most prominent part dull on percussion; situated chiefly in right iliac fossa. Sarcoma of ovary diagnosed. Operation.—Tumor invested by mesentery; lower part of ileum crossed anterior surface of capsule. Incision parallel to vessels on capsule; enucleation; right ureter had to be dissected off lower pole; hæmorrhage trifling. Inner surfaces of capsule brought together by sutures; peritoneal cavity closed, no drainage. Weight and nature of tumor.—Weight not given. A dense fibromyoma. Result of operation.—Fetid stools after fourth day; sudden death eighteenth day.

No. 8. Spencer Wells. *Loc. cit.* Beguin. Sex and age.—Female, 40. Clinical symptoms.—Four years' pain in iliac region and abdominal enlargement, which at last increased rapidly with apparent diminution at menstrual periods. Solid, central, movable, size of adult head. Operation.—Solid tumor; "its origin was clearly in the cellular tissue at the root of the mesentery proper, near the lumbar vertebræ." Ascending colon in front and to right. Blood-supply entirely from the mesenteric vessels. Enucleation, wound closed. No drainage. Weight and nature of tumor.—

Weight not given. A fibroma or fibromyoma erroneously tabulated as "sarcoma" by several writers. Result of operation.—The patient lived over eighteen years and died without any signs of malignant disease.

No. 9. Marmaduke Shield. Loc. cit. Beguin. Sex and age.—Female, 50. Clinical symptoms.—Complete procidentia for a year, abdominal swelling noticed four months. Tumor extending from ensiform cartilage down into pelvis, elastic semi-fluctuating, but no thrill on percussion. Diagnosis: Ovarian tumor. Operation.—Transverse colon and much small intestine flattened out on capsule of tumor. Strong adhesions of capsule to parietes and to tumor anteriorly; enucleation from tissues behind easy. Large vessels required ligature. Drainage. Weight and nature of tumor.—Over 9 pounds. Œdematous (myxomatous), soft fibromyoma. Result of operation.—Recovery.

No. 10. Shepherd (Montreal). Sex and age.—Male, 28. Clinical symptoms.—No pain, good health, abdominal enlargement one year. Tumor detected three months; reached from ensiform cartilage to pubes, hard, freely movable. Dullness anteriorly, resonance in flanks. Operation.—Firm parietal adhesions separated. Tumor intimately blended with its capsule of mesentery; 7 feet 8 inches of ileum resected, end-to-end anastomosis. Weight and nature of tumor.—Thirteen pounds. Fibromyxoma. Result of operation.—Recovery. Troublesome diarrhœa at first. In eight months good health.

No. 11.—Lexer. Sex and age.—Male, 41. Clinical symptoms.—Colicky pains in abdomen, turned attention to hard tumor, size of a child's head, very movable. Operation.—Tumor invested completely by mesentery; a pedicle posteriorly including connective tissue and vessels and a long coil of intestine ran on from surface. Pedicle ligatured; about 6.5 feet intestine resected. Abdominal wound closed. Weight and nature of tumor.—Five pounds. Fibroma, with myxomatous portions. Result of operation.—Discharged from hospital cured six weeks after operation.

No. 12. Murphy. Sex and age.—Female, 26. Clinical symptoms.—Round hard tumor, in left side pelvic cavity and iliac fossa; could be pushed into abdomen. Moved independently of uterus. Diagnosis: Fibroma of the ovary. Operation.—Hard tumor, ovoid, only 3 inches in diameter; invested completely and evenly by the layers of the mesentery; two feet of ileum resected; Murphy's button. Weight and nature of tumor.—No weight given. Fibroma of mesentery. Result of operation.—The Murphy's button was passed on twelfth day. No later history.

No. 13. Doran. Sex and age.—Female, 34. Clinical symptoms.—Painless swelling observed about six months. Bulky tumor filling abdomen and reaching pelvic brim and pushing uterus backwards. Soft, dull, with thrill on percussion. Diagnosis: Ovarian cyst. Operation.—Tumor tapped, little or no fluid came away; it was invested by anterior or upper layer of the mesentery; small intestines closely applied to its left border. Enucleation easy; large vessels in posterior and inferior part of capsule required ligature. Lower part of capsule fixed to lower angle of wound and drained. Weight and nature of tumor.—Thirty pounds, with two pints of serum. Fibromyoma undergoing myxomatous degeneration.

Result of operation.—Recovered; in good health three months after the operation.

No. 14. Bowers. Sex and age.—Female, 16. Clinical symptoms.—Seven months tumor. Pain and tumor left side on level of umbilicus. Freely movable. Menstruation stopped. Size large orange. Operation.—Tumor in lesser omental cavity. Strong adhesion to posterior wall of stomach. Light adhesion to surrounding structures. Pedicle attached to mesentery of transverse colon. Seemed to contain fluid. Aspirated and found to be solid. Weight and nature of tumor.—Fibroma, soft, fluctuating, discoid in shape. Result of operation.—Uneventful recovery.

No. 15. James Vance. Sex and age.—Female, 26. Clinical symptoms.—Increasing pain and discomfort for two months. Patient anæmic, cachectic, much emaciated. Nodular tumor occupying all the abdominal cavity from just below the ensiform cartilage to the pubes. Operation.—Abdomen opened, a large, round, solid tumor appeared at the upper angle of the incision, and from this solid tumor above, conforming to the contour of the abdomen, extending into the pelvis and involving the peritoneum, was the rest of the tumor, which was soft, mushy and slimy to feel; bled at every touch and exceedingly friable, without capsule or other covering and of a raw, dark red color. Pedicle of tumor easily tied off and the tumor cut away. Cavity packed with gauze, ends of the compression packs brought out of the lower angle of the wound and the abdomen closed. Death five days after operation. Weight and nature of tumor.—Fifteen cm. in diameter. Weight, 5.7 kg. (about 8¼ pounds). Fibroid with neontic degeneration in center, characteristic of round-celled sarcoma. Tumor was of the most malignant growth, and had been carried for years. Result of operation.—Death fifth day after operation.

No. 16. Dallman. Sex and age.—Male, 40. Clinical symptoms.—Constipation, bowels moving only by enemata, headache and intestinal indigestion. Symptoms for five months. Operation.—Incision from xiphoid to symphysis. Large tumor removed with difficulty from mesentery along side of vertebral column. Weight and nature of tumor.—Numerous nodular fibroid masses. Result of operation.—Cured twenty-sixth day.

No. 17. Gildermeister. Sex and age.—Female, 22. Clinical symptoms.—Obstipation with vomiting, which became fecal three days prior to operation. Operation.—Median incision and small tumor removed from front of vertebral column folds of mesentery. Weight and nature of tumor.—Fibroma with points of calcareous degeneration. Result of operation.—Recovery in twenty days.

No. 18. Ibid. Sex and age.—Female, 38. Clinical symptoms.—Premature birth one year ago, since which she noticed a movable tumor in the abdomen. Pain, constipation and dyspnœa; three months pregnant at time of operation. Operation.—Tumor removed with adherent intestine. Murphy button with anastomosis. Weight and nature of tumor.—Fibroma. Result of operation.—Recovery.

No. 19. Ibid. Sex and age.—Female, 33. Clinical symptoms.—Swelling in abdomen noticed for four years. Severe pain and diarrhœa last three months. Operation.—Tumor very adherent, removed along with

adherent intestine. Resected 23 cm. of gut. Weight and nature of tumor.—Fibroma. Result of operation.—Recovery.

No. 20. Ibid. Sex and age.—Male, 41. Clinical symptoms.—Since six months has noticed hard mass size of child's head in abdomen. Freely movable. Operation.—Tumor removed from between folds of mesentery. Resection 2 cm. Weight and nature of tumor.—2½ kg. Fibroma. Result of operation.—Recovery.

No. 21. Ibid. Sex and age.—Female, 42. Clinical symptoms.—Large growth in abdomen, giving a circumference measuring 2 meters at umbilicus. Operation.—Tumor easily removed. Origin, attachment between folds of mesentery. Weight and nature of tumor.—Twenty kg. Myofibroma. Result of operation.—Recovery.

No. 22. Duranona, L. Sex and age.—Female, 42. Clinical symptoms.—Began with abdominal pain three years ago, with enlargement. Menstruation regular. Abdomen measures 85 cm. in circumference. Operation.—Tumor removed, adhesion to intestines and epiploon. Weight and nature of tumor.—Lobulated fibroma. Result of operation.—Recovery.

No. 23. Kengla, Louis A. Sex and age.—Male, 70. Clinical symptoms.—Enlargement of abdomen first noticed three years previously. No pain or discomfort, but obstipation, which led him to consult his physician. Operation.—Tumor and involved bowel removed and anastomosis by Murphy's button. Bowel was peculiarly wrapped around tumor. Resection of involved intestine 87 inches. Weight and nature of tumor.—4½. Pure fibroma. Result of operation.—Death on third day.

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WHY GASTRO-ENTEROSTOMY IS NOT A HARMLESS OPERATION.*

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THERE has been such an appalling increase in the number of gastro-enterostomies in the past few years, that, in the mad rush the conservative indications against such a procedure have been too often forgotten. One author advises that gastro-enterostomy be done for gastroptosis; another recommends it for chronic catarrh; another that it be done in hysterical vomiting; and very many advise it in the neuroses of the stomach that mask under the name of dyspepsia. Indeed, gastro-enterostomy is said to be such a panacea for all the ills that can befall a stomach, that we naturally wonder that we are not born with a gastro-jejunostomy.

The interference with the physiology of digestion which such an operation entails is not well tolerated. The acid medium of the stomach with its pepsin is absolutely necessary for the proper digestion of the proteid foods. Again, the envelops and protoplasm of the cells of adipose tissue as well as the envelops of starch granules must first be digested in the stomach if the natural and full digestion of fats and starches is to occur in the bowel.

The vigorous churning-power of the stomach brings about not only a thorough disintegration of the various foods, and their thorough admixture with digestive fluids, but, as was shown by Kelling,¹ during this process the coarser foods are constantly being thrown back from the pylorus to the fundus by folds of mucous membrane in the pyloric region, aided by a reverse peristalsis. Only the finely-divided foods can pass the pylorus under normal conditions. Kelling pro-

* Read before Chicago Medical Society, June 13, 1906.

duced a fistula of the pyloric region and another of the fundus in dogs and observed that only pulverized food came through the opening of the pyloric end, while coarse pieces came through that of the fundus.

He also found that the pylorus becomes spastic and closed when acid solutions are introduced into the stomach, and Hirsch and Von Mering demonstrated that the introduction of foods into the duodenum hinders the emptying of the stomach. Neither of these phenomena occurred in animals with gastro-jejunostomy, and the absence of these normal reflexes explains the fact that the stomach empties itself long before it has accomplished its proper work.

Pawlow² has shown that hydrochloric acid is a specific excitant of the pancreatic gland, but has no effect if it is retained in the stomach, or introduced into the jejunum. It acts only in the duodenum and it is here, and here only, that its powerful effect on the flow of the pancreatic juice is observed. Kelling's carefully conducted experiments not only confirm Pawlow's work, but show that the same thing is true for the flow of bile.

Hence the flow of both the pancreatic juice and bile is brought about reflexly by stimulation of the duodenum with hydrochloric acid, and this is in harmony with the fact that the flow of these fluids rises and falls in undulatory fashion with the entrance and exit of the acid food-mixture in the duodenum. Under conditions of gastro-enterostomy, a small continuous stream of bile and a very small stream of pancreatic juice flows, which are far below the demand of the normal intestinal digestion, and this explains the observations of Heinsheimer and Jesslin, that after gastro-enterostomy fats and albumins are, at best, only partially digested and a large part is recovered in the stool.

One of the functions of the sudden and excessive flow of bile and pancreatic juice upon the entrance of the acid stomach contents into the duodenum, is the neutralization of them, and we find, under normal conditions, an alkaline reaction of the contents of the jejunum. In gastro-enterostomy, where this

does not occur, we find that not only does this acidity interfere with the action of the bowel ferments, causing imperfect digestion, but the irritation of the acid itself brings on functional disorders and severe diarrhœas which are very difficult to treat and may cause death. Two such cases are reported by Anschutz³ from the clinic of Mikulicz. This diarrhœa is sometimes further complicated by an uncontrollable vomiting which is due to a mixed peristalsis just as in the case of peritonitis. Monprofit⁴ has given the question considerable study and concludes that besides the factors already mentioned, there is a further irritation of the bowel mucosa by the sudden increase in diet reaching it. Matthes⁵ injected artificial stomach secretions into the jejunum and in all cases brought on a catarrhal enteritis. Carle and Fantino⁶ say that the diarrhœa in cases of reduced hydrochloric acid is due to an intoxication with fermentation products and thus explain the diarrhœa in cases of carcinoma.

In the jejunum, near the anastomotic opening, there is not uncommonly developed an ulcer, which may come on weeks or months after the operation. Tiegel⁷ reports twenty-two cases in individuals operated for benign stenosis of the pylorus. Jahr⁸ reports one case, and Watts⁹ reports fourteen cases and includes an experimental observation of perforation of a jejunal ulcer in a dog following gastro-enterostomy. The clinical picture is variable; either there are no symptoms unless a perforation occurs, or there are present the usual picture of pain, and blood in stomach contents or in the stool. These ulcers resemble the peptic ulcers of the stomach, being often round and punched out in appearance.

Their etiology is obscure, just as in the case of ulcer of the stomach. But a causal rôle is undoubtedly played by the acid stomach contents which strike the jejunum unaccustomed to such an insult. Then, too, because of the premature emptying of the stomach the foods are coarse and cause mechanical injury. Kocher,¹⁰ in reoperating some of his cases of gastro-enterostomy observed circular contractions of the bowel just below the anastomotic opening. Thus a cul-de-sac is formed,

in which, owing to the prolonged contact of the food with the bowel, stagnation occurs and ulceration may follow.

As a further evidence of the baneful influence of the acidity, Tiegel points to the fact that these cases have all occurred in individuals who have had a gastro-enterostomy for benign disorders of the stomach, in whom the hydrochloric acid was normal or in excess. The occurrence of these jejunal ulcers is more frequent than suspected, for many remain latent and may give symptoms only at time of perforation.

The surgeon frequently has asked himself the cause of recurrence of symptoms in cases where the pylorus was not interfered with and a gastro-enterostomy done. This has had a rather ingenious explanation through the work of Kelling, who found that even with a large gastro-enterostomy opening, the food continues to pass by preference through the pylorus if it is at all patent. This is due to the peculiar anatomic arrangement of the musculature of the stomach, and is further influenced by the intra-abdominal pressure which more than equalizes the apparent advantage of a lower point. Owing to disuse, the artificial opening contracts and may even close.

The vicious circle, so common in the past, is unusual now, owing to the much-improved technique. But still cases occur in the hands of the most expert, no matter what type of operation is done and with no plausible explanation. For some obscure reason it has been found that there is a special liability to postoperative pulmonary complications in stomach cases, in particular, pneumonia and infarcts.

Most ulcers of the stomach heal medically if intelligently and persistently treated. Leube reports a medical cure in three-fourths of his cases. It is the complications of ulcer which alone may demand surgical interference. It is seldom that ulcers can be excised, for they are frequently multiple and when simple are usually so adherent to surrounding structures that their removal would be dangerous, if not impossible. Brenner,¹¹ in a careful review of the entire literature, advises against resection of ulcer in majority of cases, where gastro-enterostomy is done.

Likewise in hæmorrhage of the stomach, the bleeding point or points can seldom be found, and most surgeons admit that it is folly to operate while hæmorrhage is taking place unless distinct indications are present. Such bleeding is usually venous and, as a rule, is successfully checked by medical means. On the contrary, when repeated small hæmorrhages occur which menace the life of the patient, surgical means must be resorted to. Kocher, Quenu and Petersen, as well as others, report cases where the hæmorrhage continued and caused death, even when gastro-enterostomy was done.

CONCLUSIONS.

1. The stomach may be looked upon as an organ for the protection of the bowel. The normal functions cannot be improved upon by any operation, and gastro-enterostomy is at all times a dangerous operation.

2. The functional disorders of the digestive tract which occur after gastro-enterostomy and may seriously interfere with nutrition, and the severe diarrhœas which may come on, are due not only to the premature emptying of the stomach, but also to the failure of neutralization by the bile and pancreatic juice of these acid products. This deficiency of bile and pancreatic juice is due to the absence in the duodenum of the hydrochloric acid, which stimulates both of these to flow.

3. The numerous recorded cases of ulcer of the jejunum following gastro-enterostomy and their persistence of symptoms, if not fatal termination, lead us to advise gastro-enterostomy only as a last resort.

4. The neurasthenic individuals who suffer from chronic dyspepsia not only are not benefited by gastro-enterostomy but are made worse. This also applies to the dyspepsia due to imperfect mastication.

The so-called atonic dilatation of the stomach and gastroptosis, either alone or as a part of a general enteroptosis, never are benefited by gastro-enterostomy.

6. No operation is indicated in acute ulcer, unless perforation is imminent or has occurred, or serious hæmorrhage compels it.

7. Gastro-enterostomy is not indicated in chronic ulcer of the stomach, unless there are repeated small hæmorrhages which menace life, grave adhesions, or persistence of marked symptoms even after prolonged and thorough medical treatment.

8. Gastro-enterostomy should always be done where the natural evacuation of the stomach is impossible and pyloroplasty or gastro-duodenostomy are not feasible. This includes the cases with mechanical obstruction due to pyloric stenosis, and malformations due to hour-glass contractions or disabling perigastric adhesions. When the operation is done it is best to close off the pyloric opening.

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SURGICAL TREATMENT OF PERFORATING GASTRIC ULCER.¹

WITH REPORT OF THREE CASES, TWO ACUTE AND ONE CHRONIC.

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CASE I.—H. K., aged 26, white, laborer, single, born in Philadelphia, admitted to the Pennsylvania Hospital March 6, 1906.

Previous History.—Strong and healthy, but during the past six months has had more or less frequent attacks of indigestion, with pain and occasional vomiting; on two or three occasions the vomitus contained blood. Half an hour before admission the patient was standing on a box about two feet high, lifting a sack of oysters from the ground. He suddenly felt a sharp, cutting pain in the abdomen, and fell off the box, striking his left side. In a few moments this pain was intense. On examination there were no marks of contusion on the body. The abdomen was very rigid, particularly over the epigastrium, and there was exquisite tenderness in this region. He complained that the abdominal pain was agonizing. The pulse was good, but the temperature subnormal; sweating profuse; countenance drawn and pinched. He vomited once a small quantity of stringy mucus. The last meal was taken about five hours before the onset of the attack.

Diagnosis, acute, perforating gastric ulcer.

Operation was begun three hours and a half after the onset of the first symptom; anæsthesia with ethyl chlorid, followed by ether. A four-inch incision was made in the median line between the ensiform and umbilicus, and on opening the peritoneum a frothy fluid of pale green color was found free in the abdomen. The stomach, which was flaccid and empty, was immediately explored, and a hard, indurated mass found half an inch from the pylorus on the lesser curvature. The pylorus was brought into

¹ Read before the Philadelphia Academy of Surgery, October 1, 1906.

the wound and walled off with gauze. The thickened area was partially covered with lymph, with a distinct dimple at one point from which white scar-tissue radiated, evidently the cicatrix of an old ulcer. No fluid was escaping, nor was an opening visible until the lymph was removed, when a thin pale fluid flowed out of a perforation about the size of a match head. This was inverted with a double row of Lembert sutures of Pagenstecher thread, and a piece of omentum tacked over the line of suture. A cigarette drain was carried down to the region of the ulcer and the abdominal wound closed with through-and-through silkworm gut sutures, the rectus fascia being united with a running catgut stitch. A buttonhole incision was made just above the pubis and a glass drainage tube inserted to the bottom of the pelvis. The abdomen was not flushed and the region of the ulcer alone was sponged. The patient was placed in bed in almost a sitting position and continuous enteroclysis used after the method of Murphy.

March 7.—The patient's condition is excellent. There is no pain; the water by bowel is well retained; temperature 100; pulse 80; bowels have moved once; very little drainage from the suprapubic opening.

March 8.—The patient has developed a bronchitis, with considerable cough and yellowish expectoration. The temperature is 100; abdomen slightly tender; bowels have moved once; no drainage from the suprapubic incision. The drainage tube was found to be entirely surrounded by omentum, which had penetrated the small openings and completely blocked up the tube. It was necessary to give the patient ethyl chlorid and to ligate and cut away a portion of the omentum before the tube could be removed. Water was given in drachm doses every 15 minutes. The convalescence from this time was uninterrupted. By the end of a week he was on a soft diet of eggs, custards, etc., which was gradually increased to the ordinary house diet. Cultures taken from the peritoneal cavity at the time of operation were entirely negative.

CASE II.—D. L. B., aged 27, white, single, bartender, born in New York; admitted to the Pennsylvania Hospital April 21, 1906.

Previous History.—Has always been healthy, though given to slight excesses induced by his occupation. For a week pre-

vious to admission he had been feeling out of sorts, with some indigestion and general malaise. There was no vomiting and no previous history of indigestion.

While straining at stool he was suddenly seized with sharp epigastric pain, which rapidly became agonizing. He was admitted to the hospital within half an hour of the onset of the symptoms. The epigastric region was found to be of board-like rigidity, with exquisite tenderness. The pulse was good; temperature subnormal; countenance anxious.

Diagnosis, acute perforating gastric ulcer.

Operation was begun within an hour of the onset of the first symptom. Anæsthesia, ethyl chlorid, followed by ether. A four-inch incision was made through the inner border of the right rectus between the ensiform and umbilicus. There was no soiling of the general peritoneal cavity, although it contained a slight excess of fluid. The stomach, upon examination, was empty, and an indurated area was felt on the posterior wall near the pylorus, very close to the greater curvature. The gastro-colic omentum was torn through and the lesser peritoneal cavity found moderately soiled by gastric fluids. The indurated area on the posterior wall showed a perforation a little larger than a pin's head, which was partially covered with lymph. This opening was inverted with Pagenstecher thread and then whipped over with catgut. The lesser peritoneal cavity was sponged dry, but as it was feared that some of the fluid which it contained had found its way into the general peritoneal cavity during the operation, it was deemed advisable to drain the general cavity through a suprapubic incision with a glass tube. The upper abdominal wound was closed with a small cigarette drain leading to the lesser peritoneal cavity. The patient was placed in bed in a nearly upright position and continuous enteroclysis given.

April 22.—Condition remarkably good; free drainage from the suprapubic wound. Placed on drachm doses of water every 15 minutes.

April 23.—All drainage removed; enteroclysis discontinued; bowels freely moved. For the rest the convalescence was uneventful.

The night of the Fourth of July, after spending the day down the river with some companions, and having partaken of 14 or 15 bottles of beer and a large amount of cold indigestible food,

he was seized with severe pain in the region of the stomach, with active emesis. Vomiting brought relief but was followed by a few hours of epigastric tenderness. At the end of 24 hours he was as well as ever. After such a test of overloading the stomach there is little doubt that the healing of this ulcer was complete.

These two cases are types of acute perforating gastric ulcer in which rupture takes place without warning, and where the patient is in apparent health and leading his normal life. In both, muscular effort was the exciting cause of the rupture, and in neither were there any peritoneal adhesions, although lymph had been thrown out in the first case in sufficient amount to temporarily close the opening.

The points in these cases to which I would invite discussion are, first, the question of drainage; and, second, whether gastro-enterostomy should or should not have been done.

1. Drainage.—In Case I the abdomen was opened three hours and a-half after the onset of the first symptom. Soiling of the peritoneum with a greenish fluid was moderate and general as far as the eye could reach. In view of the after history, as the suprapubic opening drained for 24 hours only, it seems probable that sponging or flushing the peritoneal cavity with closure of the wound without drainage would have been a safe procedure.

In the second case the lesser peritoneal cavity alone was contaminated at the time of operation, and drainage of this area with a gauze wick would perhaps have been all that was needed, although the tube leading to the bottom of the pelvis gave free drainage for 36 hours.

The reasons which led me to drain both these cases were, first, I have no fear of drainage, believing that if it does no good it is at least not a source of danger in a modern hospital. Second, I desired to use the method practised by Murphy for the treatment of general peritonitis—the exaggerated Fowler position; continuous enteroclysis, etc., and one of the essential steps in this procedure is a suprapubic opening to remove all fluids that drain into the pelvic cavity.

Granting that both these cases might have recovered with-

out drainage, I still think their chances were slightly improved by using it.

2. Gastro-enterostomy.—In each of these cases the patient reached the operating-table in excellent condition. There was no necessity for hurry, and had there been any strong indication for gastro-enterostomy it could readily have been done. It was not done, first, because there was no external evidence of other ulcers being present either in the stomach or duodenum; and, second, because closing the perforation did not diminish the calibre of the pylorus.

If we consider the question of gastro-enterostomy from a mechanical standpoint only, it will be indicated when one of the three following conditions is present:

1. Multiple ulcers of the stomach or duodenum. When there are several ulcers and the one that has perforated alone is treated, *i. e.*, closed by suture, we leave the stomach in practically the same condition that it was in previous to the rupture, as nothing has been done to remove the sources of irritation which led up to the perforation. Each ulcer that remains is therefore a potential source of rupture. There is also the danger of hæmorrhage, which is ever present in a gastric ulcer.

2. Where suture of the perforation causes narrowing of the pylorus or duodenum to such an extent that the passage of food will be interfered with, gastro-enterostomy will be necessary to drain the stomach and prevent dilatation of that organ, with stagnation of food.

3. Where firm closure of the perforation cannot be accomplished through direct suture, and an omental patch has to be used, gastro-enterostomy is clearly indicated to prevent distention of the stomach and consequent strain on the patch. I say clearly indicated, but not imperatively, for I saw a case with my colleague, Dr. Gibbon, in which an omental patch was used to close an opening that could not be sutured, and recovery ensued without a gastro-enterostomy. In this case all foods and liquids were withheld from the stomach for a period of three weeks, the patient being nourished entirely by the rectum.

Unfortunately, these mechanical considerations cannot

alone be our guide in the performance of a gastro-enterostomy, for the operator must carefully consider the following questions before it can be safely undertaken:

1. Is the condition of the patient sufficiently good to stand the lengthening of the operation by 20 or 25 minutes?

2. Is its performance likely to spread an already present infection or open up a new avenue for infection? For instance, the whole lesser peritoneal cavity will be open to infection when a posterior gastro-enterostomy is done for a rupture on the anterior wall of the stomach.

3. Can it be postponed to a later date when the patient's condition has improved and the peritoneal cavity is free from infection, the stomach in the meantime being placed absolutely at rest and the patient tided over by rectal alimentation?

If this last query can be answered in the affirmative the question is at once in abeyance, and its ultimate decision may be left to a more favorable time. As Mayo has suggested, a conservative and palliative operation with a living patient is better than a brilliant and completed one at a greatly enhanced risk.

I am indebted to Dr. D. E. Kercher, the attending physician, for the notes of the following case:

CASE III.—Chronic perforating gastric ulcer. Death from inanition. Mrs. L. H., aged 51; housewife; white; American. Mother died at the age of 57 of an injury; father and one brother died of tuberculosis.

Previous History.—Has always been fairly well; no children; normal menopause at 45. In June and July, 1902, she had frequent attacks of paroxysmal abdominal pain, which was not localized. Occasionally slight jaundice accompanied these attacks. They seemed to be traceable to dietary indiscretions. The abdomen was tender and there was slight rigidity in the region of the appendix. Rest with regulation of diet brought about entire relief.

September 19, 1902.—Another attack of severe abdominal pain, with tenderness, lasting several days.

December 12, 1902.—During the night she was seized with

severe crampy pains in the lower abdomen, with marked tenderness and tympany. There was also slight tenderness and rigidity in the splenic region. The temperature was $100\frac{4}{5}$; pulse 110; complete anorexia. She lies on her back with knees drawn up.

This attack was treated with ice locally, and starvation. In three days the tenderness had disappeared, except over the region of the appendix, but the temperature had risen to 102.

Pelvic examination showed a small, retroverted, adherent uterus; otherwise negative. Leucocytes 16,000.

At the end of ten days, as the tenderness still persisted over the appendix, operation was decided upon and this organ was removed by Dr. Kercher. At the same time the adhesions about the retroverted uterus were broken up and the fundus brought forward. The appendix was considerably injected, with a small hæmorrhagic area about one inch from the cæcum, and in the last three quarters of an inch the lumen was obliterated. For a week after the operation the temperature remained elevated, reaching 102, and then gradually declined. The recovery was complete. For six months she was free from pain, except for an occasional slight paroxysm in the epigastric region.

June 3, 1903.—At 3 A.M. she had a violent attack of stabbing pain in the right upper abdomen, which radiated to the left chest and into the bladder. The urine at this time was scanty, and on standing deposited a dense pink sediment. In a few hours constant nausea with retching developed. At the end of 24 hours there was frequent vomiting of dark brown stercoraceous material. The abdomen was greatly distended, with rigidity and tenderness in the epigastric region. For several weeks the temperature ran a distinctly septic course, ranging from 100 to 103. Epigastric tenderness was continuous, but otherwise there was little discomfort. On the 14th day pain was felt in the left lung, and an area of dulness could be mapped out in the mid-axillary line at the level of the eighth interspace. This gradually became more distinct, and on the twenty-fifth day during a fit of coughing she felt something burst in the left chest and immediately began to expectorate foul-smelling pus. Microscopic examination showed this pus to contain streptococci and staphylococci, but no tubercle bacilli. There was prompt amelioration of all the symptoms; the purulent expectoration lasting four weeks.

The appetite returned; she gained greatly in weight, and felt in better health than for many years.

This interim of comfort lasted until February, 1906, about two years and a-half. At the beginning of this month she felt stitchy pains in the base of the left lung at the site of the former trouble. On February 8, while attending a matinee, she was seized with such pain in the epigastric and splenic region that she had to leave the theatre and be taken home in a carriage. By the time she reached home the pain was agonizing. There was considerable cough and she complained of being chilly. Temperature 100; pulse 108; respirations 28. Examination of the chest revealed only a few crackling rales over the lower left lung posteriorly. Ice was applied to the epigastrium and morphia given hypodermically. In 24 hours the entire upper abdomen was very rigid, but the pain had diminished. Leucocytes, 17,200.

There was dulness over the lower border of both lungs posteriorly, with crackling rales and bronchial breathing. The cough was severe; expectoration rather scanty, but on three or four occasions it showed a characteristic rusty appearance. This condition of the lung continued for a week, when the cough became free, the physical signs of consolidation disappeared and she was fairly comfortable. The tenderness in the epigastrium and the rigidity, however, remained, and pain was most severe when the stomach was empty and was always relieved by taking food.

February 22, 1906.—The epigastric pain again became very severe and boring in character, with nausea followed by frequent vomiting. The vomitus was black disorganized blood. The stools were also tarry.

At this time I was called in consultation. I found the patient suffering an agony of pain; abdomen distended; rigid in upper portion; exquisitely tender. The diagnosis of chronic perforating ulcer was made, and in view of her former attacks of slight jaundice and the relief of pain on taking food the ulcer was thought to be in the duodenum. Immediate operation was advised and accepted, and the patient at once removed to the Methodist Hospital.

Ether anæsthesia. A six-inch incision was made through the right rectus muscle between the ensiform and umbilicus. The right side of the upper abdomen was found free from adhesions.

The gall-bladder and liver were normal, and the foramen of Winslow admitted the tip of the finger. To the left of the median line the viscera was densely matted together, and on breaking up the adhesions under the left lobe of the liver a large abscess was opened which extended posteriorly beneath the stomach. This cavity contained thick grumous pus filled with small dark blood-clots, and on introducing the finger the tip seemed to enter the cavity of the stomach. The stomach was immovable and the adhesions were so dense that it was impossible to expose the perforation. As the condition of the patient was not very good it was deemed advisable to drain the abscess cavity with a rubber tube and gauze, the incision being closed with interrupted silk-worm-gut sutures.

Reaction was prompt following the operation and there was immediate relief from pain. Slight nausea persisted but no vomiting. The drainage through the tube was very profuse, dark and flaky, with an odor of gastric contents. The patient was placed on nutritive enemata, and normal salt solution was frequently given by rectum. The discharge from the drainage-tube varied from 80 to 120 ounces in 24 hours, and it required but one minute for liquid taken by mouth to drain from the wound. Everything swallowed seemed to pass out through the drainage-tube. As nutrition could not be maintained the patient gradually sank, and died on the twelfth day of exhaustion.

Autopsy.—At the autopsy it was found impossible to expose the posterior wall of the stomach until the intestines had been removed from the abdominal cavity, the pylorus and œsophagus severed, and the firm adhesions binding the stomach to the posterior abdominal wall cut with a knife. The stomach was much contracted, the walls thick, and its posterior surface at the cardiac end contained a perforation the size of a silver dollar, with hard indurated edges. This perforation represented about one-third of the extent of the posterior wall of the stomach. The entire lower lobe of the left lung and the lower edge of the right lung showed recent consolidation.

From this history it is evident that the attack of June 3, 1903, was due to a perforation of this ulcer into a region that had been sufficiently walled off with adhesions to prevent a general infection. Slow leakage took place; a subphrenic abscess was formed,

which perforated the diaphragm and discharged itself through a bronchus in the left lung.

The question comes up, Could anything else have been done at the time of operation except drainage of the abscess cavity? From the post-mortem dissection it was readily seen that an exposure of the perforation would have been impossible unless steps had been taken to remove the entire stomach. Therefore closing by suture was out of the question. In view of the density of the adhesions to the pancreas and the obliteration of all anatomical landmarks in this region, complete removal of the stomach would have been impossible during life. Our thought, therefore, was to drain the abscess with the hope that this cavity might be obliterated by adhesions and fibrous tissue, and during this time to support the patient by rectal feeding.

There was one other procedure which might have been tried had there been much improvement after operation; namely, a jejunostomy, for the purpose of feeding the patient and placing the stomach completely at rest, thus favoring the closure of the perforation by fibrous tissue. In this way the patient might have been tided over until she had gained sufficient strength to stand a more radical operation, or even a recovery might have ensued.

ACUTE GENERAL PERITONITIS WITHOUT DEMONSTRABLE LESION.¹

BY EDWARD MARTIN, M.D.,

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CASE I.—A. L., (referred by Dr. Wilcox), aged 9 years, with a negative family and personal history, had been generally miserable for two weeks. On the day previous to her admission to the hospital she was seized suddenly with severe epigastric pain, accompanied by vomiting. The vomiting was repeated, and on the following day was accompanied by diarrhœa.

On her admission her temperature was 101.4, pulse 54, and respiration 28. She lay on the right side with her legs drawn up. The abdomen was universally tender, this symptom being perhaps more marked over McBurney's point. The muscles were rigid but not markedly so. There was absent peristalsis and repeated regurgitant vomiting. White blood-count 59,640. The diagnosis of general peritonitis was made, probably dependent upon perforative appendicitis or typhoid perforation, and immediate operation was performed. This showed the belly full of sero-pus with congested but not markedly inflamed intestines. Cultures showed a pure streptococcus infection. There were no pseudomembranes and the operation was completed in a few minutes, the belly cavity being thoroughly drained. The appendix was normal.

The patient died on the third day from septic intoxication. A searching post-mortem examination revealed no cause for the peritonitis.

CASE II.—L. L., aged 10 months; referred by Dr. Hoban; was seized with fever and constipation lasting one day and relieved by a teaspoonful of castor oil. A week later while seated in a high chair the latter tipped forward. The child was, however, caught before she struck the floor, though her abdomen struck against the guard common on such chairs. She cried for half

¹ Read before the Philadelphia Academy of Surgery, October 1, 1906.

an hour, was peevish some little time after this, and then seemed as well as ever and her accident was forgotten,—even her diet, which contained among other things, bologna sausage, not being changed.

On the second day following the fall the child had a temperature of 104° . Calomel was given in 1/10-grain doses for three days, 3 grains in all being administered, but without result, though the mother had reinforced the doctor's efforts by syrup of figs and castor oil on her own responsibility. Because of the persistent constipation, intestinal obstruction was suspected and about two dozen enemata, some containing turpentine, were given without effect. The fever subsided, but vomiting became a more and more distressing feature of the case. During two days more large doses of castor oil, calomel and some croton oil were administered. On the fifth day of symptoms and the seventh day after the accident the child was admitted to the Howard Hospital. She was breathing 46 to the minute, with temperature of $100\frac{2}{5}$ and pulse imperceptible at the wrist. Vomiting was effortless and frequent, a thin, greenish material welling out from the mouth and nose. Abdominal palpation showed a rigid tympanitic belly, dull in flanks, and absent peristalsis. The child was treated by enemata, normal salt solution and whiskey being passed in slowly under very gentle pressure. The pulse improved in quality until it could be counted 144 to 154 at the wrist, but the child died in a few hours without showing reaction enough to justify any intervention which seemed to promise success. A careful autopsy was performed which failed to show any visceral lesion. The peritoneal cavity was full of extremely foul milky pus containing flakes of lymph. Bacteriological examination of this discharge was not made.

CASE III.—M., aged 8 months; two or three days after a slight abdominal trauma, began to cry and vomit. Treated by purgatives to no effect. I saw her on the third day of her illness, when she presented a swollen, tympanitic belly, full in the flanks, without peristaltic sounds, a weak rapid pulse and hurried respirations and the facies of profound toxemia. There had been no bowel movement and vomiting was recurrent and regurgitant in type. The parents absolutely refused operative intervention and the child died in the course of 36 hours. Opportunity for complete autopsy was not given. The stomach and

intestines were removed and most carefully examined. There was no inflammatory or perforative lesion.

These three cases occurring in my own experience suggest that we are possibly going through a period of over-reaction against the dark ages, when acute suppurative peritonitis without visceral or parietal causative lesion was regarded as common. We are now used to finding a visceral lesion in cases of acute peritonitis and our operations, even those of emergency, are so planned as to reach the cause of the inflammation. When we fail to find a definite local focus from which infection has spread we are prone to attribute this to an error in diagnosis, and an incomplete exploration usually necessitated by the profoundly septic condition in which these patients come to operation.

That there is or has been a lesion in cases of peritonitis following slight trauma cannot be doubted. It is certainly true, however, that this lesion may be beyond macroscopic detection. The indications for evacuation of pus and relief of tension are none the less absolute. It would seem advisable in cases of acute diffuse septic peritonitis in the absence of a preceding history pointing to a definite causal lesion to be content with an incision in the right lower abdominal segment, thus permitting a rapid exploration of the region from which most abdominal infections originate. If no causal lesion be found nor evidences of gastro-intestinal perforation further exploration should be omitted. This exploratory operation in the case of adults should be performed under local anæsthetics. With the majority of children the effect of fright and pain is far more depressing than that of a general anæsthetic, hence in them nitrous oxide should be used, since their struggle against it is brief and it is without serious after-effect.

ANEURISMAL VARIX.

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ANEURISMAL VARIX is defined as a pulsating swelling caused by an opening of communication between an artery and a contiguous vein. It has no aneurismal sac, and is to be distinguished from a varicose aneurism, which has such a sac between the artery and vein communicating with both. It is generally admitted that these lesions are regularly the result of traumatism, commonly incised, stab- or shot-wounds involving an artery and a contiguous vein. A noteworthy exception is the not infrequent occurrence of pulsating exophthalmos without traumatic history, this syndrome being often caused by the presence of a communication between the carotid artery and the cavernous sinus at the side of the body of the sphenoid bone.

The ophthalmologists have studied this condition carefully and their work would go to prove that in this location at least aneurismal varix may be caused by pathologic conditions other than those secondary to traumatism. De Schweinitz states that only 60 per cent. of some hundred cases listed gave any history of traumatism, in view of which statement it seems probable that a careful study of a large series of cases of aneurismal varices of the extremities might cause surgeons to modify their views as to the necessity of a traumatic origin.

From a surgical standpoint aneurismal varices naturally divide into two classes differing widely in their adaptability to treatment. First, those occurring in the neck and upper extremity. Second, those of the abdomen and lower extremity.

Surgically these classes exhibit a most important and striking difference, those of the first allowing the free application of ligation methods without marked danger of gangrene, on account of the perfect and abundant collateral circulation exist-

ing at their respective sites ; while on the contrary, in the second class, vascular conditions make similar methods extremely hazardous from the great frequency with which gangrene follows the simultaneous ligation of vein and artery in the lower extremity. It is, therefore, most desirable that methods other than the classic treatment of double ligation of the vessels with extirpation of the sac or point of communication be adopted.

The symptoms of aneurismal varix are striking. Soon, or during the healing of a wound that affects the blood-vessels, there will appear a pulsating tumor over which can be felt a marked thrill, and heard a harsh bruit. There will also be progressive enlargement of the distal veins to which will be transmitted the thrill and bruit. There will also be pain, numbness, swelling and disability of the affected extremity.

Time seems to offer no cure for these lesions and as a rule the disagreeable symptoms increase with years, although there may be no very great change in the objective signs.

In true aneurismal varix the treatment must be purely operative, as there is no aneurismal sac to be affected by pressure and the other means used in the treatment of other forms of aneurism. Nothing but methods which entirely stop the circulation at the affected point are of avail.

A time-honored method is double ligation of the vessels with or without extirpation of the affected segment and the sacculated dilatation that often exists in the vein opposite the point of entrance of arterial blood. This is effective and gives satisfactory results in the neck and upper extremity, but in the lower causes too high a percentage of gangrene with loss of limb, or even life, to justify its routine adoption.

Direct suture of the opening in the arterial wall after the method of Matas is the operation of choice in these cases, and possibly in all suitable cases no matter where located. The procedure can be varied according to the conditions present. The dilated vein can be opened by a direct incision and the arterial gap located and sutured through this opening, the vein then ligated above and below the lesion and its walls sutured

in tiers over the arterial suture, as is done in the Matas operation for popliteal aneurism.

The recent improvements in the technic of vascular suture would seemingly make possible the suture of the communicating opening through an incision in the vein followed by suture of this latter defect, leaving the circulation unimpaired in both vein and artery. Or, after locating the point of communication the artery and vein could be carefully separated and the opening in each sutured.

It has also been proposed to shut off the opening of communication by a ligature passed around it without opening either vessel. This does not seem a probable method of cure, as such a ligature would need to be permanent and might then cause ulceration and subsequent hæmorrhage or relapse. Dr. C. H. Mayo reports a successful use of this method in one recent case in the popliteal region.

In all cases any method of treatment is more readily applied the more recent the case, the less dense and abundant the scar-tissue, and the less permanent dilatation and tortuosity has been caused in the affected veins.

In very old cases, especially when resulting from shot-wounds, the conditions at the time of operation may be such as to make any formal procedure extremely difficult.

I have to report such a case occurring at the elbow-joint, caused by a charge of buckshot at close range, producing a compound fracture of the lower end of the humerus with sloughing of most of the soft parts about the joint. Healing was much delayed, and pulsation was noticed in the wound before it was completely closed. The man finally recovered with a partly ankylosed elbow and an aneurismal varix which he neglected until it had reached a large size, and until the pressure of the immense veins upon the ulnar nerve caused intolerable pain and much muscular weakness:

September, 1903, E. H., American, married. Five years ago, in a quarrel, patient was shot in the left arm and side with a load of buckshot, much damage being done about the elbow-joint



FIG. 1.—Aneurismal varix before operation.



FIG. 2.—Condition of arm immediately after operation for removal of aneurismal varix.

The wound suppurated and healed slowly, and before it healed a pulsating swelling was noticed opposite the elbow. This has slowly increased in size and for the past year there has been great pain in the arm, referred to the ulnar region.

On examination, patient has a very marked varicosity of the superficial veins on the ulnar side of the forearm, extending from the wrist upward to the middle of the arm. (Fig. 1.) The veins are three-quarters of an inch in diameter and pulsate vigorously. At the elbow there is a pulsating mass over which a harsh bruit is heard and thrill felt. The same loud bruit is heard at a point one and a half inches above the wrist on the ulnar side, and to a less degree over the whole mass of varicose veins. Patient's general condition is good; no history of syphilis or other constitutional trouble. There is partial ankylosis of the elbow joint, and the anterior and lateral surfaces of the forearm at the elbow are a mass of scar-tissue interspersed with medium-sized veins.

Operation September 26, 1903. An incision was made over the mass at the elbow-joint, and an attempt was made to isolate the aneurismal site by dissection. This was found to be impracticable on account of the large amount of scar-tissue filled with good-sized vessels, so the dissection was carried upward into the arm until a healthy area in the brachial artery was laid bare. This vessel was then doubly ligated with catgut. The large veins of the forearm were next exposed and removed from the wrist up to the aneurism. At the wrist was found a large communication with the deep veins of the forearm, and upon opening the fascia a vessel over one inch in diameter was found in close juxtaposition to the ulnar nerve, running from the wrist to the elbow. This was also removed, and the radial and ulnar arteries were ligated just below the bifurcation of the brachial and about five inches below the first ligation of the brachial artery. The large wound was sutured in layers without drainage and the arm was protected by voluminous dressings.

The hand was cold and circulation poor for the first forty-eight hours, after which the conditions improved and the case went on to uneventful recovery. There was no necrosis of the skin except an area three-fourths by one-fourth of an inch at the site of the first incision in the scar-tissue at the elbow, probably due to rough handling during the early part of the dissection. One month after operation the patient returned to his former

vocation of guide and oarsman at a hunting resort, being entirely relieved of the pain in the ulnar-nerve region and having no pulsation at the site of the aneurism and none in the radial artery. During the next year he complained of coldness in the arm, especially during the winter months.

April, 1905, there is good pulsation in the radial artery at the wrist. Patient got drunk and fell and injured his arm, resulting in an abscess near the elbow which was very slow in healing.

This case is unusual on account of its long duration and the extreme distention of the veins with the resulting pain, numbness and disability. The operation was unusual only in the extensive removal of the dilated veins, and this was done because it was thought that the long duration of their distention would preclude their return to anything like normal calibre. Microscopic examination of such dilated and varicose veins regularly shows great overgrowth of connective tissue arranged irregularly, the wall of the vein being in some places greatly thickened and in others much thinned by dilatation. It is difficult to understand how such conditions could disappear even after entire removal of the abnormal arterial pressure.

The result after three years seems to justify the operative methods, as at the present time the man has a useful arm and earns his living as a guide and oarsman at a hunting resort. He has now a fair radial pulse and the circulation of the limb seems perfect except about the elbow in the dense scar. In this region on two occasions since the operation he has suffered from obstinately sluggish ulcers. On both occasions he fell and bruised his elbow severely while intoxicated, causing abscesses which refused to heal promptly after evacuation. The appearance of the resulting ulcers was much like those seen in embolic gangrene, where the tissues seem to be half dead but will neither become frankly necrotic nor take on healthy action towards healing.

This sluggish ulceration was, however, probably due more to the character of the scar-tissue than to the shutting off of the circulation by the operation, as the ligations of the radial and ulnar arteries were both above their recurrent branches,

and that of the brachial below both profundæ branches, so that the anastomotica magna was the only considerable branch whose circulation was interfered with.

It is to be noted that the ulceration occurred on both sides and was equally sluggish in healing in each locality, while the anastomotica magna and its branches is distributed mainly to the ulnar aspect of the elbow.

It was my intention to directly attack the seat of communication in this case and either suture the opening, after Matas, or doubly ligate and extirpate the portion of veins and artery immediately about the abnormal opening. On attempting to expose the vessels the density of the scar, and the fact that it was traversed by many large noncollapsing veins, were thought to be prohibitive, so the operation was completed by the ligation of all vessels comprised in the varix as near as possible to the seat of the perforation and incidentally the extirpation of the two very-much-dilated veins on the ulnar side of the forearm, which were considered the cause of the ulnar-nerve symptoms.

COXA VARA.

BY RICHARD J. BEHAN, M.D.,

OF PITTSBURG, PA.

UNTIL very recent years, medical men only considered three lesions of the hip joint, namely, fracture of the head or neck of the femur, tubercular disease, and dislocation. All diseases referable to the hip were classed under one of these three, yet in many cases there were present lesions which could not be referred to either of the three classes, and to these unnamed conditions various names were given. For instance, in the hip we have arthritic deformities occurring the same as they occur in the wrist, or metacarpo-phalangeal joints. These arthritic deformities, if their location is in the neck of the femur, cause a change in the angular relationship of the neck to the shaft of the bone, and we have an increase of the angle with a consequent abduction of the leg, giving us the condition called coxa valga, or a lessening of the angle, giving us the condition called coxa vara.

Coxa vara is a deformity of the upper end of the femur, in which the normal angle formed by the neck and the shaft of the bone is lessened. Young seems to have evolved the best classification. It is as follows:

A. *Coxa vara adolescentium*.

B. Other forms of coxa vara: 1, congenital; 2, associated with congenital dislocation of the hip; 3, due to osteomalacia; 4, due to osteomyelitis; 5, due to osteitis fibrosa; 6, due to tuberculosis; 7, due to senile atrophy; 8, due to arthritic deformans; 9, due to unknown causes; 10, due to traumatism.

Coxa vara may also be classed as true coxa vara and false coxa vara. The true variety includes all those cases which arise from defective resisting power of the neck, this lessened resistance being produced by a non-inflammatory lesion, and is most common in adolescents. The false variety is caused by a lesion, the result of inflammation or traumatism. Royal

Whitman¹⁷ claims that this deformity belongs to the same class as the knock-knee and bow-legs of adolescence.

We will consider only the coxa vara adolescentium, or true coxa vara, or, as it is sometimes called, static coxa vara. It is a non-inflammatory softening of the neck of the femur, due to defective nutrition, and is followed or accompanied by a yielding to pressure and a downward bending and torsion. (Blanchard.)

History.—In the literature no reference is made to such a condition previous to 1843, when it was mentioned by Roser.²⁴ It was again described in 1851 by Zeis,²⁵ in 1857 by Richardson,²⁶ who showed a case before the Philadelphia Pathological Society, in 1886 by Monks,²¹ in 1888 by Keetley.²³ In 1890 Rotter¹⁹ presented a case of coxa vara before the Medical Society of Munich. The first to call attention to it as distinct disease was Fiorani in 1881. Hofmeister of Tübingen coined the name in 1897, but Ernest Mueller first studied and described it (reporting four cases) in adolescents, in 1889. Keetley³³ claims priority to Mueller. In 1896 it was first introduced to the notice of British surgeons by Ogston of Aberdeen. Royal Whitman¹⁷ some two years previous had in a very interesting article drawn the attention of the American physicians to it.

Etiology.—1. Congenital.—Due according to Kirrmisson and Kredel to intra-uterine pressure from malposition of the foetus in utero. Of eighty-three collected cases six occurred as congenital. Hoffa believes that congenital coxa vara is due to some arrest of growth during intra-uterine existence, probably due to some affection of the bone. He has encountered six unilateral and five bilateral cases.

2. Pathologic.—Local disease in the neck of the femur. In some cases of coxa vara where resection of the upper part of the femur was performed, rachitic changes were found in the neck of the bone. Keetley of London, England, removed a wedge-shaped piece of bone from a case; examination of the piece of bone removed showed rickets.

Frauenstein examined a specimen from a rickety child

who died from other causes and found bending of the femoral neck, which was not suspected during life. Nelaton claims that local rickets, or as it is generally called, late rickets, is one of the potent causes.

Osteomyelitis also causes a weakening of the neck and a consequent deformity from pressure and torsion. (Oberst.) Arthritis deformans is classed by Young as a cause of this affection, and while it does cause a coxa vara, the lesion is not the true variety. Tuberculosis and inflammation are given by Sir Thornely Stokes as preceding factors, but according to later authorities must be excluded.

3. Structural weakness.—Owing to improper development of the lamella of the femur, the increasing weight of the body causes a sagging down of the femoral head. This likewise may be due to an inherited or relative delicacy of the structure of the bone, Mikulicz,³⁰ Humphrey,²² Arndt,³¹ holding this view.

4. Traumatism.—This is not a particular cause of the true coxa vara, but generally is a cause of a coxa vara, producing as it may: (1) Separation at the epiphyseal line, (2) Fracture of the neck; the fracture may be complete or incomplete.

Sudek claims that coxa vara is often of traumatic origin and is very apt to be produced by sudden weight thrown upon the femur by young persons whose bones are not yet rigid. Sprengel³² claims that coxa vara is always traumatic and is always due to a fracture or an epiphyseal separation if it begins abruptly and with much pain and is unilateral. He also claims that separation of the epiphysis will produce a condition where the limb healing in an abnormal position will simulate coxa vara.

5. Trophoneurotic.—According to Senn the innervation of the joint may become affected, thus producing a lessened nutrition in the neck of the bone and a consequent softening. This may follow disease, as diphtheria, etc.

6. Occupation.—Kocher, Konig. This factor is active, most frequently in young males whose occupation necessitates

prolonged standing with the legs abducted as in the case of cheese-makers, also in those following some of the agricultural pursuits.

7. Arthritis deformans will cause a coxa vara, but is differentiated from the true variety in that we have inflammatory and neoplastic deposits involving the neck of the femur, especially the base. Also we find them involving the acetabulum.

8. Ostitis fibrosa.—Kuster.

9. Early rickets.—Michael Cohn.¹⁰ Measurements of skeletons show that slight bending of the neck of the femur and slight elevation of the trochanter major are frequently encountered after severe rickets in infancy. Fabrikante⁶ also maintains that coxa vara is generally due to rickets.

10. Of 83 cases of coxa vara adolescentium: 6 were congenital, 5 were between 2-5 years, 5 were between 6-7 years, 2 were between 7-8 years, 7 were between 9-10 years, 1 was between 10-11 years, 3 were between 12-13 years, 4 were between 13-14 years, 11 were between 14-15 years, 19 were between 15-16 years, 11 were between 16-17 years, 3 were between 17-18 years, 2 were between 18-19 years, 2 were between 20-21 years, 1 was 24 years. Senn has recently reported a case occurring at forty-five years. Up to 1898 only one case of coxa vara in adults had been reported and that one was due to osteomalacia (De Quervain⁸). Normally in early infancy the neck has a more obtuse angle with the shaft than it has in adult life. Humphrey²² claims that this sinking of the neck normally terminates in adolescence and that if the condition does not terminate then, or else progresses too rapidly, we have a coxa vara developing.

11. Sex.—Of 109 cases, 83 were males, 26 were females. The cause of the rarity in females may be due to the following factors:—1, In females the shaft is more oblique. 2, The neck is shorter and stronger and lies more in a line which would represent the prolongation of the shaft. Therefore (in females) the pressure is transmitted in a more direct line than it is in the male femur and any increase in weight of the body or

disease of the bone itself would not be as apt as in the male of altering the normal angle of the neck with the shaft.

12.—Fracture was given as a cause of this condition by Kirmisson¹³ in 1898, but according the interpretation of the majority of observers, the fact that fracture has occurred excludes coxa vara.

13.—Sudden over-exertion, as in the case of Mosetig. Froelich³⁷ of Nancy points out the resemblance which is due to the rapid growth of the subject and tarsalgia. Both are characterized by pain, muscular contraction, deformation of the bones, and sometimes arthritis of a dry type.

Pathology.—On macroscopic examination the neck of the femur is seen to form an angle less than normal with the shaft. The normal angle is— 125° – 126° , (Mikulicz); 126° – 129° , (Lauenstein); 120° , (Porter); 130° , in children; 110° in adults, (Young); 128° , (Sir Thornely Stokes and J. Lacy Firth). In some cases of coxa vara the head may be depressed to such an extent that it is below the level of the top of the great trochanter. The angle may be less than 90° . This produces a shortening of the limb and limits its abduction. In all rickety bones the same condition is found, the line of curvature being an exaggeration of the normal. There is also a posterior curvature causing the neck of the femur to bulge anteriorly so that it sometimes can be felt as a hard lump in the base of Scarpa's triangle. This produces eversion of limb.

Bending of the neck of the bone continues and is comparatively rapid until the resistance of the compressed bone is sufficient to oppose further increase of the deformity or until the head of the bone rests upon the trochanter minor as in Hoffa's specimen. (Fig. 1.)

No inflammatory changes can be noted in or around the joint; no effusion into the joint is present. Sprengel³² in 1898 reported two cases in whom on resection a loosening of the head of the femur in the epiphyseal line due to slight trauma was found. The characteristic deformity was present.

Histologic examination of 16 specimens showed: 3 with

rachitic changes, 6 with practically normal structure, 2 with arthritis deformans, 5 with juvenile osteomalacia.

The following is an outline of the bone which Hoffa²⁰ obtained by resection from one of his cases.



FIG. 1.—Marked bending of neck of femur. (Figure shows outline of normal neck and of neck bent down upon the lesser trochanter.—HOFFA.)

Symptoms.—1. Onset.—The onset may be sudden or gradual and the first complaints of the patient may be: (1) PAIN (shooting, Mannoeh; dull aching, Firth; sharp lancinating, Case III) and tenderness in the hip joint radiating on the inner and anterior surface of the thigh to the knee. (Fowler, p. 531.) Both pain and tenderness may be absent, though a prolonged standing produces a temporary feeling of soreness in the vicinity of the right hip. On resting the limb the pain disappears to reappear when the weight of the body is again placed on the affected limb, as in my Case III; if when walking the pain would be too severe the patient always rested himself against a lamp post or against the side of a building and immediately the weight was taken off the diseased limb he found great relief, but the pain would again return on his attempting to walk. All of these may be absent and the only complaint of the patient may be: (2) a slight LIMP,—which always occurs on the affected side. This limp is due to: a shortening of the

limb, (measurements being taken from either the anterior or superior spine of the femur to either: *a*, the lower border of patella, or *b*, the inner malleolus) which is both apparent and real. The real shortening, which varies from $\frac{1}{2}$ to $1\frac{1}{2}$ inches, is due to the faulty angulation of the neck; while the apparent shortening is due to the elevation of the pelvis on the affected side so as to permit the limb which on that side is in a position of adduction, to assume a position parallel with the other femur, the adduction may vary from 30° to 50° .

Blanchard's case is:

Of the right limb.—Apparent shortening, 1.5 inches; Minus adduction shortening, .75 inch; Real shortening, .72 inch; as compared to the measurements of the left leg.

Right leg.—Adduction deformity of 30° ; Rotation out of 40° ; Flexion of thigh restricted, one-third. Trochanter prominent, 1 inch above Nelaton's line. Gluteal crease $1\frac{1}{2}$ inch above the left.

The case is one of bilateral coxa vara. Note.—shortening of right leg, especially external rotation: also that in the (*a*) left leg 50 per cent. of abduction is lost, and that the greater trochanter lies $\frac{3}{4}$ inch above Nelaton's line, hence left leg is $\frac{3}{4}$ inch short, and since the shortening of the right leg was derived from measurements of the left, therefore the right leg is 1.5 inches short. (*b*) The limp is also partly caused by an external rotation of the femur. This is due to the traction of the muscles and ligaments, and may be as much as 40° to 60° . It is also a result of the anterior convexity of the neck.

After a short time,

2. Atrophy of the affected limb becomes apparent.
3. The gluteal crease on the affected side becomes depressed, according to Senn and Fowler, while in Blanchard's case it was elevated.
4. Right trochanter is prominent, generally (above Nelaton's line; Blanchard's case, displaced backwards).
5. Flat foot is generally present.
6. Genu valgum generally present. Keetley holds that in

many cases of genu valgum the knee deformity is a compensatory curve to a certain degree of coxa vara.

7. Temperature: fever is absent.

8. The general health of the patient is good.

9. Static scoliosis sometimes present when the affection is unilateral (Fowler).

10. Function of the hip joint. Fowler says that there is no loss of function except that due to mechanical difficulties, while Senn says that function is sometimes seriously impaired from the beginning.



FIG. 2.

11. Gait in the bilateral variety. Because of the adduction of both thighs with inability to abduct them beyond the line representing the longitudinal axis of the body, the patient is unable to move one knee past the other and the mode of progression is as follows: One foot is advanced forward, then the other foot is brought up until its knee almost touches the popliteal space of the first; then the first is again advanced forward, etc.

12. Bryant's triangle.—The normal Bryant's triangle is

an isosceles triangle with the perpendicular and horizontal sides both equal. In a case of coxa vara generally both the horizontal and perpendicular lines are affected, the horizontal lines being shorter than the normal, showing an upward displacement of the trochanter of the femur (Fig. 4), and a consequent shortening of the neck of the bone. The perpendicular line is also increased in length, showing an eversion or turning outward of the femur, as in the case of Mannock's,¹⁴ in which double coxa vara was present. Bryant's triangles were as follows (Fig. 3) :

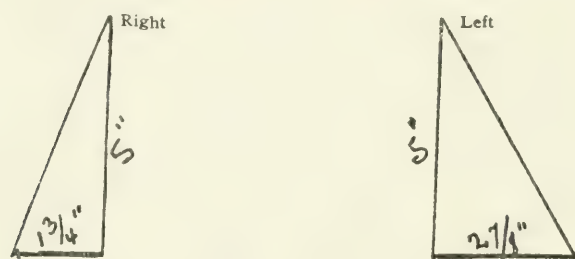


FIG. 3.—Showing variation in Bryant's triangles in a case of coxa vara.

13. Lordosis, especially in the double variety (Mannock).
14. Knock-knee frequently present.
15. Rickety signs, such as bending of the ribs, knock-knee, etc., are frequently present.
16. Abduction is limited in the bilateral variety; the thighs can only be abducted so that the two limbs are parallel with each other.
17. Adduction is unimpaired.
18. Rotation. Arc of rotation is greatly impaired. Not more than 10° on left side, not more than 15° on right side.
19. Flexion. Generally limited. When the limb is flexed beyond the point where the foot touches the knee of the opposite side, rotation of the thigh outward takes place so as to cross the extremity in tailor fashion (Ogston). Flexion of the limb increases the deformity, as may be explained by the position and shape of the acetabulum, its upper and posterior margin being most prominent. Thus it interferes with the prominent

trochanter so that on pronounced flexion the adduction takes place and the tissues are markedly distended by the projecting greater trochanter; thus, owing to the prominence of the trochanter, the assumption of the sitting position is often painful, or rather the change from the erect to the sitting position. (Whitman.¹⁷)

20. Thomas's test is absent. The popliteal space of the affected side comes in direct contact with the table.

21. Urine is normal.

22. Standing position in bilateral variety (Mannock's case): When standing erect with limbs close together, the toes of the right foot merely touch the heel of the left foot at an acute angle.

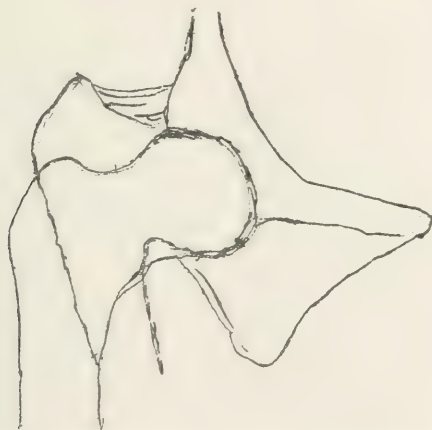


FIG. 4.—Showing elevation, trochanter major in coxa vara.*

23. Face: According to Keetley there is a characteristic alteration of the bones of the face, a sort of expansion and an appearance of thinness in the orbital and nasal regions.

When all other means of diagnosis fail and we are still in doubt, we turn to the X-ray. In the radiograph:

1. We notice no inflammatory changes in or around the joint—no fractures, no separation of the epiphysis, nothing, only an apparent difference from the normal in the angle formed by the shaft and the neck, this yielding is not only from above downward, but is also from side to side, and this

fact, if all the other conditions are excluded, makes our diagnosis.

Diagnosis.—This condition should be diagnosed from: 1, Congenital dislocation of hip; 2, hip disease; 3, local diseases, as osteomalacia; 4, traumatic coxa vara (fracture); 5, acute infantile paralysis; 6, ostitis deformans of hip.

The differentiated diagnosis is as follows:

ONSET.—Coxa vara, may be abrupt, generally gradual. Tuberculosis of head or neck of femur, slow. Fracture, abrupt, following an injury. Ostitis deformans, generally slow. Infantile paralysis, abrupt, follows fever.

MOTION.—Coxa vara, abduction and rotation generally impaired, but slightly restricted. Tuberculosis of head or neck of femur, all motion is greatly restricted. Fracture, restricted because of pain. Ostitis deformans, restricted because of new growths. Infantile paralysis, restricted because of muscular paralysis.

PAIN.—Coxa vara, slight or absent, referred to the front of the knee being carried up by the anterior crural. Tuberculosis of head or neck of femur, generally present on slight motion; referred to the back or inside of the knee carried by the genicular branch of the obturator. Fracture, present. Ostitis deformans, present. Infantile paralysis, negative.

FEVER.—Coxa vara, absent. Tuberculosis of head or neck of femur, generally present. Fracture, absent. Ostitis deformans, generally absent. Infantile paralysis, present early in disease.

DEFORMITY.—Coxa vara, early in disease may precede the pain. Tuberculosis of head or neck of femur, late in disease. Fracture, early in disease. Ostitis deformans, late in disease. Infantile paralysis, none.

TENDERNESS OVER JOINT.—Coxa vara, absent. Tuberculosis of head or neck of femur, present. Fracture, present. Ostitis deformans, often present. Infantile paralysis, none.

NOCTURNAL TWITCHINGS.—Coxa vara, absent. Tuberculosis of head or neck of femur, present. Fracture, absent. Ostitis deformans, absent. Infantile paralysis, absent.

MUSCULAR ATROPHY.—Coxa vara, slightly marked. Tuberculosis of head or neck of femur, well marked. Fracture, generally absent early in disease. Ostitis deformans, present. Infantile paralysis, present generally in a particular group of muscles.

SHORTENING.—Coxa vara, early in disease. Tuberculosis of head or neck of femur, late in disease. Fracture, immediately following accident. Ostitis deformans, slight. Infantile paralysis, absent.

AGE.—Coxa vara, generally in adolescents. Tuberculosis of head or neck of femur, young people. Fracture, generally in old people. Ostitis deformans, generally old age. Infantile paralysis, infancy.

JOINTS INVOLVED.—Coxa vara, generally unilateral, may be bilateral.

Tuberculosis of head or neck of femur, generally unilateral. Fracture, generally unilateral. Ostitis deformans, seldom or never involves only one joint. Infantile paralysis, generally both sides.

X-RAY.

ANGULATION OF NECK OF FEMUR WITH THE SHAFT.—Coxa vara, no pronounced angulation. Tuberculosis of head or neck of femur, at first not much change in the angulation. Fracture, generally pronounced. Ostitis deformans, generally no change. Infantile paralysis, no change.

ANGLE FORMED BY NECK WITH SHAFT.—Coxa vara, angle may be reduced to 60° . Fracture, generally very acute. Ostitis deformans, normal. Infantile paralysis, normal.

DIRECTION OF YIELDING.—Coxa vara, from above downward and from side to side. Tuberculosis of head or neck of femur, generally in only one direction. Fracture, generally in one direction. Ostitis deformans, none. Infantile paralysis, none.

INFLAMMATORY DEPOSITS, ETC.—Coxa vara, absent. Tuberculosis of head or neck of femur, present especially about the neck of the femur. Fracture, none at first. Ostitis deformans, present about head, neck and acetabulum. Infantile paralysis, none.

ADDUCTION.—Coxa vara, present. Tuberculosis of head or neck of femur, absent? (Mannock).

ABDUCTION.—Coxa vara, absent. Tuberculosis of head or neck of femur, present.

ROTATION. Coxa vara, outward, arch of movement of the trochanter is not diminished. Tuberculosis of head or neck of femur, outward the arch of movement of the trochanter major is diminished.

Prognosis.—The prognosis depends upon the extent of the deformity of the femoral neck but in general it is good, and the functional results will be excellent. Hofmeister gave the results in thirty-two cases, in all of which the patients recovered sufficiently to return to their original work. Under five years the prognosis according to De Quervain is good, as rickets is generally the cause and under appropriate treatment it will disappear.

Treatment.—In the acute stage the patient should be put to bed and the affected limb placed in a Buck's extension or in a plaster cast; at the same time phosphorus should be exhibited to produce a stronger bone formation, and if there is any suspicion of syphilis the iodides may be used. Late in the disease massage and electricity are applied. Iron is also of great merit.

In case all these measures fail and the deformity is too great to permit of useful function, it may be corrected by operative measures. The operations recommended are:

1. Section of the adductor muscles with "brisement force." (Zehnder and Vulpius).

2. Excision of a wedge-shaped piece of bone from the anterior surface of the femoral neck. Kraske's method is: Incision 2 inches long, extending from above and inside the great trochanter downward along the inside of the tensor vaginal femoris. The anterior intertrochanteric line is thus brought into view. Periosteum and fibrous attachments are pushed off from the outer extremity of the neck, and a wedge removed with the osteotome from its base, dividing the bone at this point.

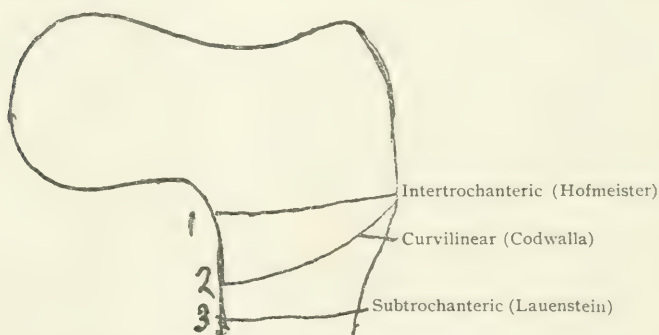


FIG. 5.—Various lines of section of femur in osteotomy for coxa vara.

This operation is condemned by König unless it can be done extracapsular.

3. Osteotomy: Straight linear subtrochanteric (Hofmeister); oblique linear subtrochanteric (Hoffa).

4. Resection. *a*, Of bone: Subtrochanteric (Kocher); transverse subtrochanteric (De Forest Willard). *b*, of joint: (Hoffa, Sprengel), in very grave cases of deformity. In one of Hoffa's cases by resection the shortening was reduced from 7 inches to 3 inches.

Froelich has been successful in curing coxa vara by resection of the great trochanter and rest in bed for six weeks.



FIG. 6.—Case I. Right limb is the one affected.

REPORT OF CASES.

CASE I—Helen P (2-23-06). Onset, latter part of last July, at age of 3 years and 8 months. "Went to bed well and woke up with it. She got up out of bed and fell over." She had been complaining of slight hip pain for a day or two previously.

Paralysis of entire limb. Could not walk for one week, but finally could take a step or two.

Pain, at time of inability to walk, over entire knee. Also about two weeks ago, for a couple of weeks. At the present time the limb can be moved in all directions without pain.

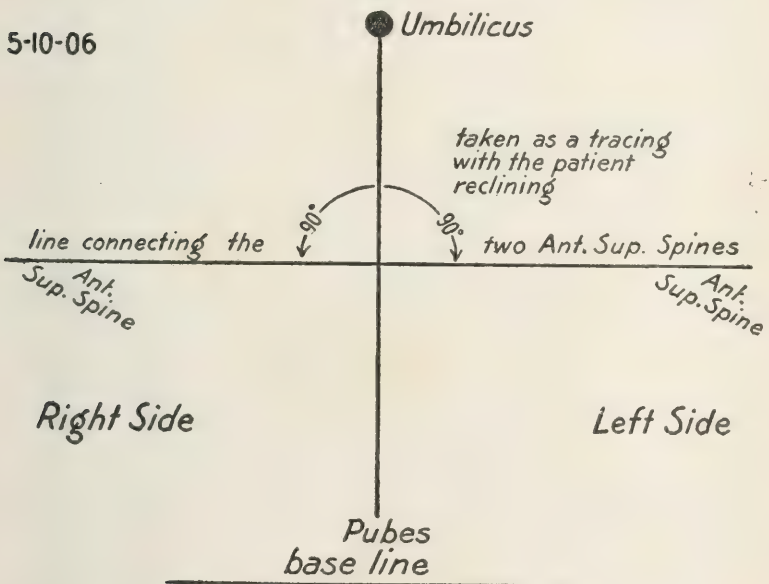


FIG. 7.—This shows how, on reclining the tilting of the pelvis is corrected.

Motion in affected limb is improving. It has become freer though the present limitation has been present for four months.

Bowels normal, urine normal, night cries absent, appetite good.

History.—Past, very healthy, was breast fed. Family history of T. B. negative. At the time of onset of this lesion, she had no fever, no temperature, and did not seem to be at all sick except for the inability to walk.

Examination.—Position right limb. State of adduction and ext. rotation.

Atrophy.—Present ; no particular group of muscles.

Motion.—No limitation of motion, either on elevation, rotation, abduction, or adduction.

Tenderness entirely absent.

Walk.—Peculiar swinging gait ; wears out heel of right shoe on the inner aspect. On walking the side of the foot is on the ground and at each step she makes a peculiar double motion with the foot, apparently giving the ground a little push and then allowing the foot to slip back about one-half inch, then pushing again with it, then the foot is raised and is swung forward in a semi-circle.

5-10-06

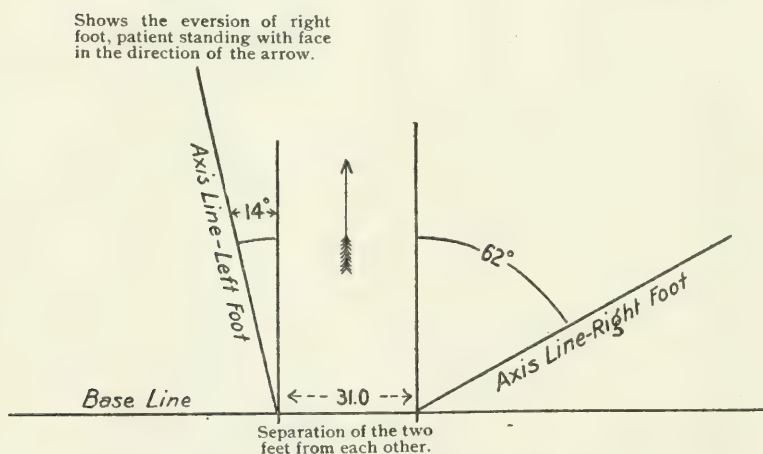


FIG. 8.—Patient lying on a flat surface in a position of rest.

Bulging.—Slight tendency to bulge on inner aspect of Scarpa's triangle.

Pelvis.—Slight tilting to right, *i.e.*, right side of pelvis is lower than the left. This was taken when she was lying down.

Creases.—Gluteal crease lower on right side.

Right limb 1.0 cm. shorter than left, from anterosuperior spine to exterior malleolus. Apparent shortening, 1.5 cm. Gluteal crease not as pronounced on right side and Nelaton's line is a little higher.

Greater trochanter on right side does not seem to be any greater distance above the Nelaton's line than the greater trochanter on the left side.

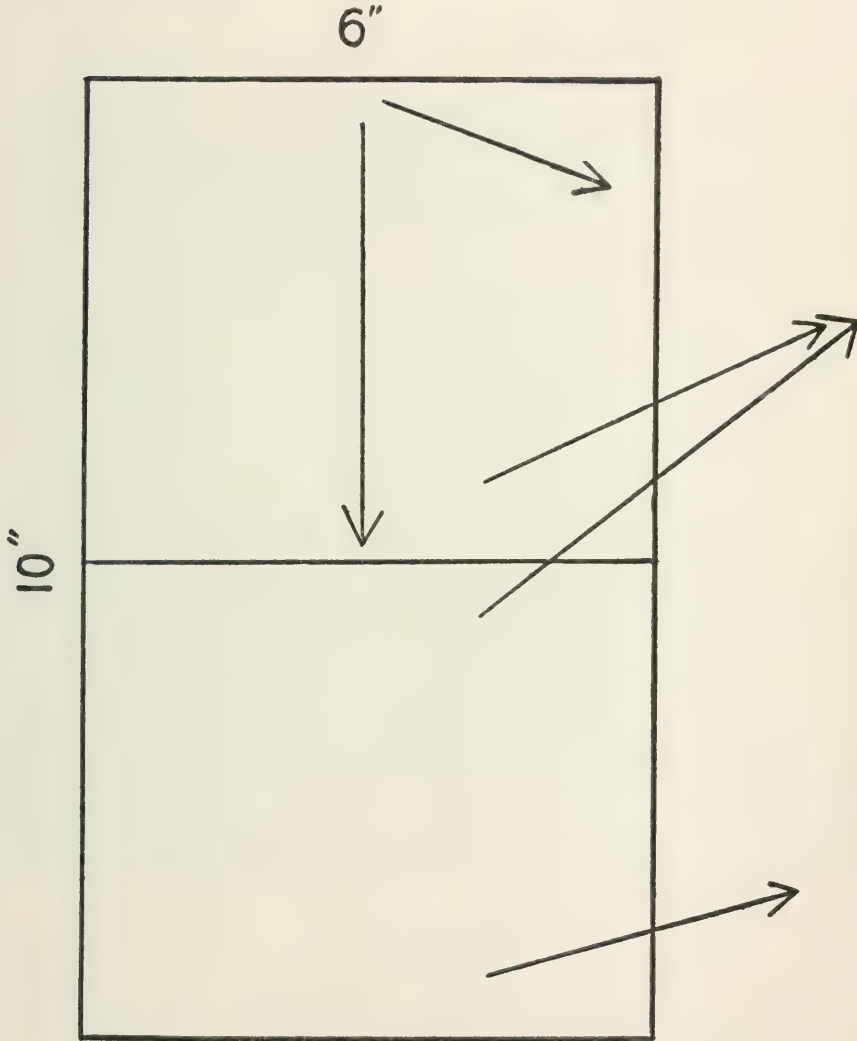


FIG. 9.

Lordosis slight; greatest curvature seems to be to the right side. On standing the anterosuperior spine on right is depressed

5 cm. and a line dropped from that point falls to the inner side of the great toe, while it falls to the outer side of foot on left side.

The right femur is adducted, while the leg itself is abducted, allowing a considerable interval between the two feet. Thus the pelvis deformity is not so great.

CASE II.—Margaret V. At present time (5-10-06), 16 years old. Onset, about two and one-half years ago, one year before the X-ray plates I here show were taken; she first noticed a slight limp on the right side, then she noticed that her dress would be higher on that hip than on the other, also that right hip was higher than the left.

Pain.—Never any pain.

History.—At seven years of age she fell off a stone wall, thirteen or fourteen feet high, landed between the wall and the house; does not remember hurting her hip at this time; there was no pain, but she fell on the present affected side. Four years ago, at twelve years of age, she fell off a fence and landed on her back; no disagreeable symptoms followed.

Examination.—No marked deformity is present. Left limb, state of exterior rotation. The adduction is possibly slight. Atrophy slight. At thigh 1.25 cm. At the calf of the leg both circumferences are the same—31 cm. Motion not much interfered with. Walk not much changed, though at the time I first saw her there was a pronounced limp. Gluteal crease is higher on left than right, though it was very slight.

Measurements.—Right anterosuperior spine to right external malleolus, 81.75; right internal malleolus, 79.5; left anterosuperior spine to left external malleolus, 81.75; left internal malleolus, 79.75.

Greater trochanter.—1.75 above Nelaton's line on the right; .25 below Nelaton's line on the left.

CASE III.—Mr. K., 42 years—clerk.

Onset.—First began about January 1, 1906, to notice a soreness in right hip; this would be particularly aggravated should he have to stand for some time.

Soreness.—Often he would lie down for a few minutes, then he would be relieved. It was always much worse towards night, while in the morning after a good sleep it would be absent. Gradually the soreness and aching increased until it became al-



FIG. 10.—Case II.

most unbearable; he says that on walking a sense of beating would be felt in the affected limb..

Pain.—On stopping and resting the limb, the pain and beating would cease, especially if he could sit or lie down. Sometimes on walking the pain would be so severe that he could not go for more than twenty-five yards without resting. The pain seemed to be present on the external surface of the limb over the greater trochanter; the bone felt as though it were jumping. Also had a slight tired feeling on the external surface of the right leg below the knee.

Limp.—About one week after he first felt the pain, a limp became noticeable; he says that his right leg would give way and be very painful whenever he would rest his weight on it.

History.—He fell down an elevator shaft, four stories in height, about three years before the development of the hip trouble. On falling he lit on both feet. No trouble was apparent afterwards until the present condition developed. In childhood he was very healthy, never being sick.

Examination.—Male. Fair state of nourishment. Right limb adducted and slightly turned in. On making pressure over the trochanter (greater) it proved rather painful. His position of greatest ease is one in which the thigh is slightly flexed; the knee bent slightly, and the foot resting on the toes of the other—the foot itself being in extension.

Scoliosis.—Left-sided.

Gait.—Slight limp on the affected side.

Gluteal depression over the prominence of the hip, the gluteal muscle is depressed.

Pelvis.—The pelvis on standing is about one-half inch lower on right than on left side.

X-ray shows a slight downward bending of the neck of the right femur. Three months after the above history was taken, I again saw the patient and found him wonderfully improved; though he still has his former limp, but to a slighter degree, the pains have disappeared and he claims he is in fairly good health.

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting held October 1, 1906.

The Vice-President, ROBERT G. LE CONTE, M.D., in the Chair.

LYMPHANGEIOMA OF THE CHEEK

DR. FRANCIS T. STEWART reported the case of an infant, who was seen by him with Dr. Robert Pitfield soon after birth. The whole right side of the face was occupied by a soft semifluctuating mass which extended from the mid-line of the upper lip back over the parotid, and from the orbit down over the lower jaw (Fig. 1), and which bulged into the mouth. The right eye was closed, the nose displaced to the left, and the mouth distorted. A hollow needle passed into the cheek withdraw a small quantity of straw-colored fluid. The skin was exceedingly thin and contained a few dilated veins but was not adherent. It was thought advisable to postpone operation as long as possible in order to give the infant a firmer hold on life. At the end of four months, however, the swelling had distinctly increased in size and there was evidence of pressure effects on the upper jaw. Immediate operation was therefore advised. The skin was reflected by an incision similar to that employed by Weber for resection of the upper jaw, and the growth, which had also extended backwards along the floor of the orbit for about one-half inch, enucleated with but little loss of blood. There were apparently no muscle fibres in the cheek and at the completion of operation nothing remained but bone and very thin skin. After resecting the redundant portion of the flap, the mucous membrane was sutured to the jaw with catgut and the cutaneous incision closed with horse-hair. Just as the operation was completed the baby ceased to breathe (ether had been employed) and artificial respiration was

needed for some minutes. Primary union was secured except at a point corresponding to the inner canthus, which healed by

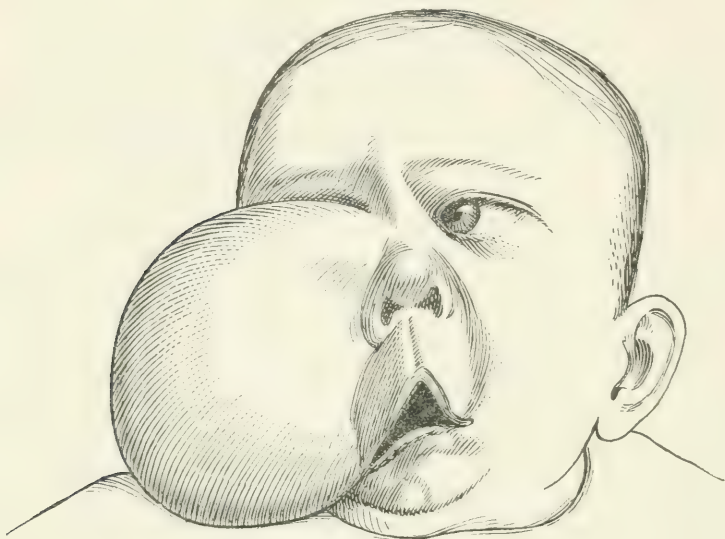


FIG. 1.—Lymphangeioma of cheek.

granulation. The right face, of course, is sunken, the nose is still displaced to the left, and the lower lid and upper lip are slightly out of alignment.

SARCOMA OF PUBES.

DR. FRANCIS T. STEWART described the case of a woman aged 38 years, a multipara, who had never had any serious illness until the present time. The family history presents nothing relevant. About one year ago she fell against the corner of a table, striking the pubes. The blow was sharp enough to make a distinct impression on her memory, but did not incapacitate her and the soreness passed away in a short time. Four months ago pain appeared rather suddenly in the region of the injury and has since caused considerable discomfort, although it was never deemed serious enough to demand the services of a physician. Quite recently a swelling was noticed in the lower abdomen, and it was for such that the patient sought advice. There had been but little loss in weight, and the anæmia which was noted was said to have been present for many years. The tumor

extended from the right anterior superior spine of the ilium to the left for $7\frac{1}{2}$ inches, and rose about $2\frac{1}{2}$ above the pubes, to the posterior surface of which it was firmly attached. The lateral extension on the right was moderately movable. The skin was at no place adherent. The growth was smooth, slightly lobulated, a little tender, and as hard as cartilage. The superficial veins were distended but no other pressure symptoms were in evidence. The growth could be felt by vaginal examination but did not invade the uterus or appendages.

Operation was performed September 15, 1906, in the Pennsylvania Hospital. A long curved incision was made from the right anterior superior spine downwards and inwards across the

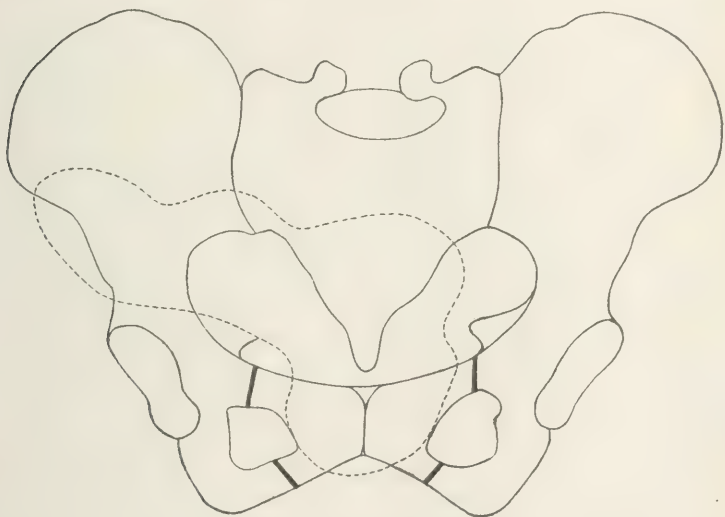


FIG. 2.—Sarcoma of pubes. Dotted line showing limits of tumor. Dark lines showing points at which bone was cut.

abdomen to the extreme limit of the growth on the left. As the abdominal muscles were invaded, they were severed above the growth, thus exposing the peritoneum which was peeled from the mass except at three points where it was so firmly adherent that it tore, necessitating the use of catgut sutures. The bladder was not involved but the growth had displaced the right external iliac vessels outwards and appropriated about two inches of the vein, which was therefore tied and severed above and below. Both round ligaments were cut and the remaining superficial

soft structures separated or divided. The lower margin of the wound was then reflected downward, and both pubic bones separated from their fellows by the chisel, the amount of bone removed measuring four inches transversely (Fig. 2). The obturator vessels on the left were preserved, those on the right were sacrificed. Beginning on the left, the bone was elevated after some difficulty and forcibly turned to the right as the muscular and ligamentous attachments were severed. It was possible to suture a portion of the lateral muscles on the right to Poupart's ligament, but the recti had retracted to the umbilicus and, as the operation had already consumed about two hours, no plastic work was attempted. The skin-wound was simply sutured except at the middle and the right end, where gauze drains were placed. Intravenous infusion was necessary towards the close of the operation but subsequently reaction progressed unaided. The following day the right leg was somewhat bluish in color and was evidently larger than the left but there was no œdema; there was, however, a sensation of "pins and needles" in the foot and the whole limb was moved with difficulty. On the second day the drains were removed but had to be replaced because of the large amount of lymph which was discharged. Œdema did not appear until the third day and has never been excessive. On the fifth day pus appeared in the wound but the infection has been comparatively benign and will probably not mar the result. It should also be noted that there has never been any difficulty with the bladder or bowels, despite the absence of muscles over the lower abdomen.

Examination of the specimen showed that the growth evidently sprung from the periosteum covering the posterior surface of the pubes. Microscopic investigation revealed a typical spindle-celled sarcoma.

STAB WOUND OF THE INTERNAL MAMMARY ARTERY.

DR. JOHN H. JOPSON reported this case mainly because of the comparative rarity of the lesion and because it is the only instance he has encountered. The important vessels of the chest-wall that are liable to injury are the intercostals and the internal mammary. Only 15 cases of wound of the intercostals were recorded during the Civil War. In 1892 Schwartz collected 52 cases of injury of the internal mammary artery which had been

reported during the past century. Among these were seven in which the artery had been opened during operation and these he excluded, leaving 45 cases of wounds proper. Surgically the internal mammary are more important than are the intercostal arteries.

Dr. Jopson's case was that of a man of 50 years who was brought to the hospital at 10 A.M. with a history of having been stabbed a short time before. The man's clothing was saturated with blood and he was in a state of collapse, being practically exsanguinated. He was also under the influence of liquor. The wound was an inch in length, two and one-half inches to the right of the sternum in the second interspace, passing obliquely upward and inward; it was not bleeding. The resident physician applied a dressing and administered stimulants. At 1 P.M. Dr. Jopson saw the man. The wound was not bleeding, but though the man had reacted to stimulation the pulse was still of poor quality. At 4 P.M. the wound was examined and was not bleeding, but in a few minutes Dr. Jopson was called from the operating-room and found that severe hæmorrhage had begun. Compression was applied and the patient was at once prepared for operation. At this time he was not certain that the heart was not wounded. An anæsthetic was given and the wound enlarged. The internal mammary was found divided in the second interspace and both ends were bleeding. Both were tied with catgut sutures which included the surrounding muscle. Salt solution was infused, an iodoform gauze drain inserted into the pleura, and a dressing applied and the patient sent to the ward. The pulse reacted but soon went down and the man died that night. Autopsy by the coroner's physician showed atheromatous vessels. The pleura was full of blood but there had been no leakage from the ligated vessel. No other organs were injured.

Dr. Jopson said that the subject of wounds of the internal mammary artery had been specially investigated by Schwartz in his Königsburg dissertation, in which he analyzes 45 cases, as previously mentioned. Of the 45, nine died of acute hæmorrhage, which in four came from a wounded lung, heart or other neighboring structure, in 4 from the artery itself, and in 1 from an undetermined source. Of the 36 who survived the immediate effects, the wound became infected in 24, of whom 18 died and six recovered. Of the 12 with uninfected wounds, 8 recovered and 4 died.

There were 21 cases of secondary hæmorrhage, 16 in the infected group, 5 in the uninfected group. In Dr. Jopson's case the consecutive hæmorrhage was brought about by strain during vomiting. In the reported cases, secondary hæmorrhage was due in some to vomiting, in others to straining at stool, or other muscular exertion. Schwartz concluded that ligature of the vessel is not an infallible means of preventing secondary hæmorrhage. He believes that immediate ligature is not necessary, it being better to seal the wound primarily and raise the intrathoracic tension. The pleura is wounded in a large number of cases and this favors the continuation of hæmorrhage. Dr. Jopson believes that primary ligature is advisable. He also believes it would be better if we were more radical in our treatment of all penetrating wounds of the chest. Often we are too conservative in the presence of hæmorrhage, and even in the case of penetrating wounds of the chest in general. A year ago he reported a successful case of suture of the lung for hæmorrhage, and discussed the question of inserting a drainage-tube and controlling bleeding by establishing a pneumothorax as recommended by Le Conte. It is better to resort to a ligature of the bleeding vessel if it can be applied; if this cannot be done, then the establishment of a pneumothorax may be tried in hæmorrhage from the lung. In any case, even if the bleeding has ceased, infection is apt to occur. Two cases of chest wound he has had to treat in the past twelve months as empyema because of the consequent infection.

DR. EDWARD MARTIN, speaking on the general subject of penetrating wounds of the chest, put on record a case bearing on the question of hæmorrhage. A negro climbing into a window was shot in the third interspace one-half inch to the right of the sternum. When seen later he exhibited the symptoms of hæmopneumothorax and progressive bleeding. An osteoplastic flap was turned back, revealing a cut internal mammary artery which was not bleeding. The man was turned on his side and three pints of blood poured out of the pleura. A bullet-wound of the lung, though not bleeding, was sutured and the lung sutured to the parietes. Though there was evidence of use of the lung afterward, the man died in ten hours from progressive bleeding. Autopsy showed that the internal mammary had not bled but that hæmorrhage had occurred from an intercostal artery which had been cut one and one-half inches from its origin by the bullet

which had broken a rib close to the vertebral articulation. Had the X-rays been in use at that time the man might possibly have been saved. The case is recorded as an instance of a wounded internal mammary artery not bleeding and an intercostal bleeding which caused death.

DR. GEORGE G. ROSS cited a case in which he is not able to say whether or not the internal mammary artery was wounded. The subject was an obese colored woman who was shot in the right side, the bullet going across into the left side also. The patient was in shock and there were indications of hæmorrhage. She reacted, however, and as there was no external hæmorrhage operation was not performed. Ten days later Dr. Ross evacuated two quarts of foul pus from the left pleura. As the woman recovered he does not know what internal organ was injured.

DR. ROBERT G. LE CONTE said that he had carried out experiments on the cadaver to determine the frequency of injury to intercostal vessels in wounds of the chest. His results appeared to demonstrate that the intercostal artery at the lower border of a rib would not be injured unless the rib showed marks of violence. The internal mammary artery is half an inch from the border of the sternum, and in case of a wound in this locality there is always the probability of injury of that vessel, and exploration should be made. If the artery is wounded as low as the fourth or fifth interspace it is questionable if the hæmorrhage will be severe enough to cause death, while if the wound is in the second interspace the resulting hæmorrhage will be fatal unless controlled. Should the vessel be injured below the third interspace—that is, below the origin of the triangularis sterni muscle—hæmorrhage may be controlled by packing against the muscle. Dr. Le Conte has seen this done in one case. Above this point the pleura alone is beneath the vessel, and packing cannot be employed, hence resection of a costal cartilage or enlarging the wound sufficiently to expose the artery must be done. The greatest danger of hæmorrhage is of course from a vessel that has not been completely severed.

Dr. Le Conte's experience with hæmorrhage from the lung is limited, but in his few cases of severe hæmorrhage he has simply made an opening in the pleura and allowed air to be drawn in. The rapidity of the formation of complete pneumothorax can be graded as desired. If alarming symptoms super-

vene the opening can be temporarily closed, followed later by the insertion of a smaller tube. He has seen no instance of this expedient failing to control hæmorrhage, and consequently has never had to seek a bleeding vessel in the lung. It is the ideal treatment, but where the patient fails to improve resection of one or more ribs becomes necessary, with a search for and direct control of the bleeding point.

DR. JORSON, in closing, said that Schwartz's experiments on animals had shown the rapidity of bleeding from the internal mammary. A small vessel cut a short distance from the large one of which it is a branch will bleed almost as profusely as will a similar opening in the trunk itself. When the internal mammary is cut in the second interspace it is practically equivalent to making an opening the size of that vessel in the subclavian.

SURGICAL TREATMENT OF PERFORATING ULCER OF THE STOMACH.

DR. ROBERT G. LE CONTE read a paper with the above title (for which see page 907).

PERITONITIS WITHOUT VISCERAL LESION.

DR. EDWARD MARTIN reported several cases of this condition (for which see page 917).

DR. JOHN H. GIBBON regards Dr. Le Conte's first two cases as teaching the lesson that gastric ulcer is probably much more common than we think. Surgeons do not get more cases because the diagnosis is not more frequently made. In the series reported by Dr. Le Conte were two cases which gave no symptoms and in three of his own seven there was no history to lead to suspicion of ulcer. Since he reported four cases a few years ago he has met with three more as follows:

CASE I was in a man of 30 with the typical history and symptoms of a gastric ulcer for a number of years. When seen by Dr. Gibbon he had been sick 36 hours and had all the evidence of general peritonitis. Operation revealed peritonitis and also a gastric ulcer but without perforation. Drainage was established but the man died next morning. At autopsy the entire alimentary tract was removed but showed no lesion except the gastric ulcer. There was a diffuse peritonitis and no adhesions to the ulcer. Dr. Gibbon believes it is possible to get infection of the peritoneum

from a non-perforated gastric ulcer, just as this condition arises from the appendix, without macroscopic perforation.

CASE II was a man, a typical alcoholic, who had a lead-pencil-sized perforation in the anterior wall of the stomach. The patient died five days later from delirium tremens.

CASE III was the one referred to by Dr. Le Conte. There was the typical history of perforating ulcer, three-fourths grain of morphin having afforded no relief from the pain. The perforation was in the anterior wall toward the lesser curvature. It was patched up by means of omentum and the patient recovered.

Of the seven cases seen by Dr. Gibbon three recovered. In two, death was due to lateness of operation, in one to delirium tremens, and in one to faulty technic. The last mentioned died on the twenty-fourth day from obstruction of the bowel and abscess of the pelvis. The insertion of a drain is the safest procedure for the majority of surgeons. He always feels more secure when a drain extends down to the point of perforation. The question of suprapubic drainage should be decided by the length of time that has elapsed after perforation and by the quantity and character of the fluid in the peritoneal cavity. Dr. Gibbon has always used suprapubic drainage. As to gastro-enterostomy when one is in doubt as to whether the pylorus has been closed in repairing the perforation, one point is to be remembered. Experience in closing typhoid and gunshot perforations of the intestine when the surgeon believes the gut is almost closed but finds later that the lumen is sufficiently open, makes one think that the pylorus will likewise stand a great deal of narrowing. Regarding secondary gastro-enterostomy Dr. Gibbon did one 18 months after operation for perforation. He agrees with Dr. Le Conte that it is a mistake to do a gastro-enterostomy when perforation is present. It opens a new field for infection and is bad technic.

Regarding Dr. Martin's paper on peritonitis without visceral lesion, the surgeon not infrequently finds no cause to account for peritoneal infection and feels that possibly he has overlooked a lesion. It is comforting to hear that postmortem in the reported cases revealed no discoverable source of the peritonitis. Many such cases are probably due to the pneumococcus.

Dr. Gibbon is partial to local anæsthesia, but this is not satisfactory for exploring the abdomen, hence ethyl chlorid is used

for this purpose. Four thousand cases of ethyl chlorid anæsthesia are now on record at the Pennsylvania Hospital. This anæsthetic is very satisfactory, especially if it is preceded by a small dose of morphin. He did a colostomy by its aid and the man was talking to him while the dressings were being applied. It is the ideal agent for short operations.

DR. WILLIAM L. RODMAN is satisfied that the literature on the subject of gastric ulcer, in so far as perforation is concerned, has to be rewritten, as perforation is far more frequent than has hitherto been dreamed. During last May he spent a fortnight with Dr. Mayo, and during that time saw him operate on 12 cases of gastric and duodenal ulcer, and of these three had previously perforated; in all three the evidence was conclusive. Dr. Rodman has operated on three cases of perforated gastric ulcer which were latent, and previous to perforation presented not the slightest symptom suggestive of ulcer. In one instance one of the best medical men in the city had been in attendance and had not suspected the presence of ulcer.

As to the wisdom of drainage he agrees with Dr. Le Conte. It is not absolutely necessary in all cases but is very generally advisable. Suprapubic drainage is not necessary in the majority of instances but the necessity for such drainage must depend upon whether or not there has been gross soiling of the peritoneum and whether the extravasated material has wandered far from the site of perforation. If perforation occurs shortly after a meal, then suprapubic drainage would be indicated; if when the stomach is empty, it usually will not be needed. It must be remembered also that in a large percentage of cases of perforation, as shown especially by Cripps and English, the stomach contents are sterile, and far different from the intestinal contents.

As to performing gastro-enterostomy after dealing with a perforation, Dr. Rodman agrees with Drs. Le Conte and Gibbon that it is wholly unnecessary unless there be stenosis of the pylorus. Dr. Gibbon raised the question as to whether it is better to excise the ulcer than to do gastro-enterostomy. Both are in most instances unwise, but if the ulcer is accessible and the surrounding tissue not too necrotic, then excision is preferable to gastro-enterostomy. In regard to Dr. Martin's paper, he also has failed to find perforation in some cases and yet peritonitis was present. However, there is no reason why we may not find

peritonitis without macroscopic lesion of the viscera. Infection of intra-abdominal tumors may occur because of their prolonged contact with hollow viscera; and without apparent lesion uterine fibroids have become infected through the intestine or the bladder. If then infection of tumors may occur in this way why should not peritonitis be caused in the same manner? Dr. Rodman agrees in the wisdom of using local anæsthesia, but it is unwise to attempt it in the case of children. He has several times performed laparotomy under local anæsthesia, using a weak solution of cocaine. In one case he used only carbolic acid. There was no pain except when the parietal peritoneum was cut. The patient was dull and in a semi-stupor and perhaps not so appreciative of pain as the average case.

DR. JOHN H. JOYSON said that Dr. Martin mentioned finding the streptococcus in one of his cases of peritonitis without evident visceral lesion. In pediatric literature a constantly increasing number of cases of pneumococcus infection of the peritoneum are being reported. Clinically these cases are difficult to distinguish from those of streptococcus or other infection, and unless cultures are made a pneumococcus infection could not be excluded in the class of cases under discussion.

DR. FRANCIS T. STEWART has operated on seven cases of perforated gastric ulcer and in six he used drainage. Five recovered. In one he closed a perforation, did a gastro-enterostomy, and employed no drain; the patient recovered. He also omitted drainage in a case of typhoid perforation and the patient recovered. He cleans the peritoneum by irrigation with salt solution after thoroughly packing off the surrounding structures. Dr. Stewart assisted at one operation for perforated gastric ulcer in which the operator placed a drain at the site of the perforation. Leakage occurred with a resulting gastric fistula and death of the patient from inanition. Given a recent perforation, should the patient be placed in the Fowler position? If the peritonitis is generalized, suprapubic drainage should be established and the head of the bed elevated. If, however, the soiling is confined to the upper abdomen, the foot of the bed should be raised in order to prevent dissemination of the infection. Gastro-enterostomy is in a transition stage at present and its indications and contraindications are not fixed. It should rarely be performed at the time

a perforation is closed. An alarming number of cases of peptic ulcer of the jejunum have been reported as a sequel of gastro-enterostomy, a number of which have perforated. Several have been operated upon and some of these have recovered. All were foreign cases.

As to peritonitis without visceral lesion, Dr. Stewart has seen several instances in which the diagnosis was confirmed post mortem. In one case which survived, the gonococcus was found. A second case was that of a woman with a diagnosis of typhoid fever and a supposed perforation. Operation revealed peritonitis but no indication of typhoid fever and no visceral lesion. Cultures showed the pneumococcus. A third case was one of typhoid fever operated on for perforation; no perforation was found and the patient recovered. If the causative lesion be not found at once it is best to make a further careful search, as the lesion will almost always be finally located. Dr. Stewart assisted at one operation for supposed appendicitis in which suppurative peritonitis was found. Air came out of the abdomen but the operator simply removed the appendix, although that organ did not appear to be much diseased. Autopsy showed a leaking gastric ulcer which a more careful search would have located.

Local anæsthesia is often useful for exploratory purposes, but its use in these cases should be limited to the diagnosis of peritonitis. If this condition be found, general anæsthesia should be employed, as washing out of the abdomen or searching for a perforation cannot well be performed even in the adult by the use of a local anæsthetic.

DR. JOHN B. ROBERTS cited a case of traumatic ulcer of the stomach which was mistaken for a peptic ulcer. When the abdomen was opened for repeated vomiting of blood there was found a thickening of the posterior wall of the stomach near the pylorus. Dr. Roberts did a posterior gastro-enterostomy which was followed by the vicious circle. Dr. Stewart operated later for this condition, and found two sewing needles, one in the liver and one behind the stomach, which Dr. Roberts had not left in the abdomen. The woman afterward gave a clear history of having eaten pie, some months previously, in which there was some foreign body which gave intense pain at the time of swallowing. Soon after this she had profuse vomiting of blood and applied to a dispensary for treatment. The swallowed needles

were evidently the cause of the bleeding and probably caused a chronic ulcer where the thickening in the stomach-wall was felt at the time of the first operation. The case is a warning against being in too great a hurry to make the diagnosis of peptic ulcer before getting as full a history as is possible.

DR. CHARLES H. FRAZIER alluded to a case at the University Hospital operated on by Dr. Norris for strangulated hernia. The following morning the patient showed evidence of collapse and it was thought that a ligature had slipped, giving rise to internal hæmorrhage. An exploratory laparotomy revealed a perforated gastric ulcer and the abdomen filled with blood. The perforation was closed but the patient did not react from the shock of operation and soon died.

DR. JOHN B. ROBERTS said he had lost two patients from perforation of gastric ulcer a considerable time after operation in the pelvis. One was a man upon whom he had performed suprapubic lithotomy; the other was a case of extraperitoneal rupture of the bladder, doing well after incision and drainage, in which death suddenly occurred. The abdomen was found at autopsy to be full of blood from sudden perforation of an ulcer of the stomach. There may be some definite connection between septic processes in the pelvis (one of his cases had suppurated) and duodenal or gastric ulcer, just as in the case of similar ulcers developing after severe burns of the skin.

DR. LE CONTE, in closing, made clear his position regarding drainage in cases of perforated gastric ulcer. In the majority of cases seen by the surgeon the abdomen is not opened within an hour or two after perforation has occurred. When the extent of the soiling is as far as one can see or feel, then the case should be treated as one of general peritonitis, the patient placed in the exaggerated Fowler position, with suprapubic drainage and employment of the other measures advised by Murphy. If one can use this procedure with success in the presence of an extensive peritonitis, why should it do harm where the peritoneal inflammation is more limited? This method of treatment does no harm and can do good.

As to peritonitis without visceral lesion, the condition is not common, yet most surgeons have seen one or more cases. In one case seen in the Childrens Hospital, the attending physician and Dr. Le Conte had a long dispute, the former believing it to be

one of peritonitis, the latter considering it pneumonia. After a delay of 48 hours Dr. Le Conte operated and found a diffuse peritonitis but no visceral lesion to account for it. The pneumococcus was isolated from the peritoneal contents and the autopsy showed that the infection had passed through the diaphragm from a pneumonic lung. He made this error because pain is often referred to the abdomen instead of to the chest in beginning pneumonia.

DR. MARTIN, in closing, said he did not wish to be understood as advising against thorough search for a possible visceral lesion. He meant to say that in the absence of local symptoms and previous history exploratory opening may be sufficient. The Germans are the only people who can stand abdominal operations under local anæsthesia. In answer to a question by Dr. Ross, Dr. Martin said that peritonitis in the cases reported was not due to an intussusception which had been self-reduced.

STRANGULATED HERNIA OF THE OVARY IN A TWO MONTHS OLD INFANT.

DR. EDWARD B. HODGE reported this case, which occurred in an Italian child. There had been a small umbilical hernia following infection of the cord at birth, but otherwise the child was healthy. Two weeks before admission a lump appeared in the right groin and four days later the child became fretful. On a Saturday the child vomited but had a stool as the result of an enema. On Sunday it vomited a number of times and on Monday was sent to the hospital. It had been in shock but condition on admission was good. It apparently had a hard strangulated hernia. Operation under chloroform showed a thick hernial sac which contained a swollen and discolored ovary, almost black, three and one-half by one and three-fourths centimeters in size. There was no intestine in the sac. The ovary and tube were tied off and the parts repaired as well as possible. The child had good convalescence except occasional vomiting, and now appears to be well. It is a question if the condition of the ovary was not due to torsion or injury, as he is not satisfied there was constriction sufficient to cause the lesion present. To decide if there was a uterus bicornis it would have been necessary to enlarge the internal ring, and this was not considered justifiable. Hernia of

the ovary is not extremely rare but appears uncommon enough to warrant the report of a case occurring at this age.

DR. JOHN H. JOPSON believes this patient is one of the youngest subjects of operation for hernia of the ovary on record. A case of hernia of the uterus and ovary operated upon in a child of seven months has been reported by Defontaine. In cases of hernia of these organs there is frequently some congenital abnormality, as bicornate uterus, imperforate vagina, or pseudohermaphroditism. A case such as that reported by Dr. Hodge might lead to hernia of the uterus if adhesions of the ovary to the sac were present. In such cases the round ligament not infrequently is short and this aids in the production of the hernia of the uterus.

DR. GEORGE ERETY SHOEMAKER said he saw the patient referred to by Dr. Hodge three days before it was operated on. The mass in the groin was at first a small, painless swelling which he thought was infiltrated omentum. He advised temporizing on account of the baby's age, but at the end of three days the mass was four or five times as large as it was before and there was vomiting and subnormal temperature. He then sent the child to the hospital. The condition was no doubt congenital.

LARGE CYSTIC KIDNEY.

DR. JOHN H. GIBBON showed a specimen of cystic kidney in which the renal tissue had been entirely obliterated, none being demonstrable by the microscope. The question of diagnosis was interesting, the case being sent in as an ovarian cyst. In many respects it resembled that condition, but the diagnosis of cystic kidney was confirmed when the patient was put upon the operating-table. The tumor extended from the pelvis to the costal border and it would evidently have been foolish to attempt its removal posteriorly, hence it was taken out through the abdomen. It was tapped before removal and eleven pints and four ounces of fluid withdrawn. This was accomplished as easily as any nephrectomy he has ever performed. The incision was made through the sheath of the right rectus muscle, the muscle pulled aside and the sheath opened beneath it. Five or six inches of the ureter, which was as large as the thumb, were removed, with the kidney. The remainder of the ureter was not explored, though this should have been done. This point was not considered until the ureter had been ligated, and then, as the patient

was old and not in good condition, it was allowed to remain. Vaginal examination before operation revealed no stone in the lower part of the ureter. As high as 60 ounces of urine a day has been secreted by the patient since the operation. The vessels in the pelvis of the kidney were so distinct at the time of operation there was no trouble in their ligation. The vena cava was exposed for a length of six inches. Dr. Gibbon believes it is better in the case of a large growth of the kidney to go in anteriorly. Opening through the peritoneal cavity does not interfere with drainage.

DR. ROBERT G. LE CONTE stated that tumors of the right kidney are easy to remove under the circumstances narrated by Dr. Gibbon, the colon usually being internal to the mass. In the left kidney, however, the descending colon is often to the outer side and the tumor presents under the mesocolon. Consequently, the mesentery must be incised, and if the tumor is a large one the left colic artery must be divided before the removal can be effected. Ligature of this vessel endangers the life of the descending colon and is not infrequently followed by gangrene.

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